JPRS 81442

4 August 1982

USSR Report

LIFE SCIENCES

BIOMEDICAL AND BEHAVIORAL SCIENCES

No. 19

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CONTENTS

BIOCHEMISTRY

UDC: 578.826.1:578:22:547.474.6

OLIGOPEPTIDE ANALYSIS OF HUMAN ADENOVIRUS TYPES 1, 2 AND 6 AND SIMIAN ADENOVIRUS 7 HEXONS

Moscow VOPROSY VIRUSOLOGII in Russian No 5, Sep-Oct 81 manuscript received 13 Nov 80) pp 574-580

TARASISHIN, L. A., KHIL'KO, S. N., DYACHENKO, N. S., NARODITSKIY, B. S., TIKHONENKO, T. I., VANTSAK, N. P., KOVALISHIN, G. G., DREYZIN, R. S. and LOPAREV, V. N., Institute of Microbiology and Virology imeni D. K. Zabolotnyy, Ukrainian Academy of Sciences, Kiev; Institute of Virology imeni D. I. Ivanovskiy, USSR Academy of Medical Sciences, Moscow

[Abstract] Hexons of two types were studied: structural (virion, obtained from disintegrated virions) and soluble (nonstructural, extravirion, excess synthesized hexons not included in the virion). The method of peptide mapping suggested by Elder was used. It eliminates the difficult stage of producing purified proteins, since the polypeptides are separated by electrophoresis in polyacryamide gel, then gel lumps containing individual proteins are analyzed. Common peptides were found in the hexons from all sources, particularly from human adenovirus types 2 and 6 and SA7. Unique hexons were also found in all sources. Only a few peptides differentiate human adenovirus hexons types 1, 2 and 6. Figures 5; references 20: 1 Russian, 19 Western.
[170-6508]

UDC: 578.826:578.74:578.53

IDENTIFICATION OF NEW SIMIAN ADENOVIRUS ANTIGEN VARIETY (SV30N)

Moscow VOPROSY VIRUSOLOGII in Russian No 5, Sep-Oct 81 (manuscript received 12 Sep 80) pp 581-586

ZOLOTARSKAYA, E. Ye., DREYZIN, R. S., FEDORINOV, V. V., KHIL'KO, S. N., MANYKIN, A. A., NARODITSKIY, B. S. and GUROV, A. V., Institute of Virology imeni D. I. Ivanovskiy, USSR Academy of Medical Sciences, Moscow

[Abstract] A new variety of simian adenovirus, designated SV30N, is identified and studied. The virus was cloned 5 times by the plaque method on cells of line no. 4647, passed through human cells (HEp-2), passed in the presence of immune serus to SV30 or SA7, employed in transfection of infectious DNA or DNA-terminal protein with subsequent study of the virus produced, investigated for transforming and oncogenic activity. No cytopathogenic agent was obtained from a human cell culture with a preparation of SV30N. The properties of the new virus were retained after all of the treatments. The DNA of the virus was found to be 80% homologous to that of SV30, 40% to that of SA7. Polypeptide analysis showed great similarity to SV30, but some significant difference, with still more difference from SA7. The new virus also has no oncogenic activity for hamsters. References 8: 3 Russian, 5 Western.
[170-6508]

UDC: 691.69-895.71:578.833

COMBINED FOCI OF MOSQUITO-BORN ARBOVIRUS INFECTIONS

Moscow VOPROSY VIRUSOLOGII in Russian No 5, Sep-Oct 81 (manuscript received 19 Jan 81) pp 611-615

BOCHKOVA, N. G., KORESHKOVA, G. V. and POGODINA, V. V., Institute of Poliomyelitis and Viral Encephalitis, USSR Academy of Medical Sciences, Moscow

[Abstract] Results are presented from serologic studies performed in 1968-76 in 15 administrative regions in Primorskiy Kray. Some 5227 serum samples were studied using a combination of methods based on both independent and combined circulation of a number of mosquito-born arboviruses in the region. It was found that the viruses circulated among humans, horses and pigs both independently and in combined forms. Double infection of animals with Japanese encephalitis and western Nile viruses occurred in 25% of cases. By the end of the season, 98.7% divalent and polyvalent sera were obtained from pigs. References 14: 11 Russian, 3 Western.
[170-6508]

UDC: 575.24:576.85

RECOMBINATION OF CHIMERA PLASMIDS IN YEAST CELL

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 1, Mar 82
(manuscript received 29 Sep 81) pp 201-204

ZAKHAROV, I. A., KOZHINA, T. N., PESHEKHONOV, V. T., FEDOROVA, I. V. and CHEPURNAYA, O. V., Leningrad Institute of Nuclear Physics imeni B. P. Konstantinov, USSR Academy of Sciences, Gatchina, Leningrad Oblast

[Abstract] Using several plasmids with various yeast genes, the authors attempt to obtain transformant yeast cells carrying two different plasmids simultaneously. The task included study of the coexistence of such plasmids in the cell of a transformant which multiplied mitotically and determination of the possibility of recombination of the plasmids in vivo. Two plasmids were transformed simultaneously with selection of transformants by one of the selected characteristics, leucine or uracyl independence with subsequent verification by the other, to obtain yeast transformants carrying both chimera plasmids simultaneously. The transformation frequency of the yeasts for each plasmid was found to be about the same, $1 \cdot 10^{-5}$. The frequency of reversion was less than $1 \cdot 10^{-9}$. Recombination is possible between different chimera plasmids replicating in a single yeast cell, and the products can be determined genetically and described physically and chemically. Figure 1; references 11: 3 Russian, 8 Western.
[155-6508]

UDC: 577.155

CLONING OF SACCHAROMYCES CEREVISIAE ade_2 GENE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 1, Mar 82
(manuscript received 24 Nov 81) pp 224-227

SASNAUSKAS, K. V., GEDMINENE, G. K., NAKTINIS, V. I., CHITAVICHYUS, D. B. and YANULAYTIS, A. A., Institute of Botany, Lithuanian Academy of Sciences; All-Union Scientific Research Institute of Applied Enzymology, Vilnius

[Abstract] This work had as its purpose cloning in the plasmid vector of the ade_2 gene of the yeast Sacch. cerevisiae. The vector used was the recombinant plasmide pYE1 containing a small EcoRI fragment of B form of the 2-micrometer yeast plasmid supporting replication of the plasmid in the yeast cell substituted in the EcoRI section of the bacterial plasmid pBR 322. This hybrid plasmid is capable of replication both in E. coli and in yeasts. To perform the work a library of recombinant plasmids containing DNA from prototropic strain 15B-P4 of the Petergof genetic line of Sacch. cerevisiae was obtained. The recipient for the transformation was strains of Sacch. cerevisiae with genotype α $ade_2 arg_4 leu_1$. The data produced showed that the transformed ade^+ clone of the yeasts upon growth under selective conditions contains 7 to 8 copies of the recombinant plasmid $pYade_{2-1}$ per cell in addition to 26 copies of the endogenous 2-micrometer DNA plasmid. Figures 2; references 10: 3 Russian, 7 Western.
[155-6508]

UDC: 616-006.04-07:612.017.11/12

PROTEIN COMPLEXES WITH UNNATURAL POLYCATIONS--THYMUS-INDEPENDENT ANTIGENS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 1, Mar 82 (manuscript received 29 Sep 81) pp 228-230

VINOGRADOV, I. V., corresponding member, USSR Academy of Sciences, KABANOV, V. A., MUSTAFAYEV, M. I., NORIMOV, A. Sh., active member, USSR Academy of Medical Sciences, PETROV, R. V. and KHAITOV, R. M., Institute of Biophysics, Moscow

[Abstract] The immune response to ox gamma globulin was studied upon administration of various quantities of ox gamma globulin copolymer to C57BL/6 mice. Complexing of the gamma globulin with the copolymer leads to a great increase in immune response to this antigen. Preliminary administration of ox gamma globulin but not ox serum albumin in agarose significantly inhibits the appearance of antibodies specific to the ox serum albumin. The process is analogous to the sorption of polyelectrolytes on oppositely-charged surfaces of ordinary colloidal particles, causing flocculation of colloidal systems. In this case the polycation carriers bond together the necessary participants in the immune response, β lymphocytes and the antigen base, thus facilitating their necessary interaction. Figure 1; references 12 (Russian). [155-6508]

UDC: 616.995.122.21-07:616.15-097.5-078.73

REACTION OF ENZYME LABELED ANTIBODIES IN DIAGNOSIS OF PARASITIC DISEASE, REPORT 4: TEST SYSTEM FOR DIAGNOSIS OF OPISTHORCHOSIS

Moscow MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI in Russian Vol 50, No 5, Sep-Oct 81 (manuscript received 26 Mar 81) pp 28-33

PONOMAREVA, A. M., Department of Tropical Disease, Central Order of Lenin Institute for the Advanced Training of Physicians, Moscow

[Abstract] An immunologic test has been developed with high specificity and sensitivity suitable for determination of class-specific immunoglobulins and diagnosis of Opisthorchosis. The reaction of enzyme-labeled antibodies is used, with an active and specific antigen prepared from Opisthorches. The optimal parameters of the test system are determined. Its specificity is calculated and the diagnostic titer established. The diagnostic value of the reaction is determined with acute and chronic Opisthorchosis as well as the relationships of specific IgG and IgM during various periods of the disease. Sensitization of the carrier is best performed using an antigen diluted in a phosphate buffer at pH 6.8 to a protein concentration of 20 μg/mℓ. Antigen fixation time is 18 hours at 4°C, the diagnostic titer 1:100. Acute and chronic Opisthorchosis can be differentiated by the use of class-specific conjugates. References 9: 5 Russian, 4 Western. [154-6508]

UDC: 591.481.1:591.8:596

HISTOCHEMICAL STUDY OF CHOLINESTERASE IN VARIOUS VERTEBRATE END-BRAIN FORMATIONS

Leningrad ZHURNAL EVOLYUTSIONNOY BIOKHIMII I FIZIOLOGII in Russian Vol 17, No 6, Nov-Dec 81 (manuscript received 25 May 79) pp 595-601

CHERNYSHEVSKAYA, I. A., Laboratory of Central Nervous System Morphology, Institute of Higher Nervous Activity and Neurophysiology, USSR Academy of Sciences, Moscow

[Abstract] A comparative study was made of true (acetyl) cholinesterase--ACE--and pseudo (butyryl) cholinesterase--BCE in the end-brain formations of various amphibians, reptiles and mammals are determined. The work was performed on Amblystoma mexicanum, Triturus vulgaris, Rana temporaria, Eremias arguta, Testudo horsfieldi, rabbits and guinea pigs. The specifics of localization of the two cholinesterase enzymes in the end-brain formations in the sequence: amphibian-reptile-mammal show that the nature of distribution of the cholinesterases reflects the general trend of development from primitive diffuse through differentiated to highly differentiated forms. Figures 5; references 37: 11 Russian, 26 Western.
[134-6508]

UDC: 547.94

CLAVIN ERGOALKALOIDS-METABOLITES OF PENICILLIUM GORLENKOANUM

Moscow PRIKLADNAYA BIOKHIMIYA I MIKROBIOLOGIYA in Russian Vol 17, No 6, Nov-Dec 81 (manuscript received 25 Feb 81) pp 806-812

KOZLOVSKIY, A. G., STEFANOVA-AVRAMOVA, L. N., RESHETILOVA, T. A., SAKHAROVSKIY, V. G. and ADANIN, V. M., Institute of Biochemistry and Phygiology of Microorganisms, USSR Academy of Sciences, Pushchino; Institute of Microbiology, Bulgarian Academy of Sciences, Sofia

[Abstract] The structure of alkaloids from the fungus Penicillium gorlenkoanum is studied. A mixture of the total alkaloids was separated from 15 liters of culture fluid filtrate and 1.9 kg of moist biomass of a 10 day culture of fungus. The mycelia were suspended in 5 liters of a 2% tartaric acid solution, the cells broken down by a type FUG-1 disintegrator, the suspension centrifuged at 5000 g for 20 minutes. The supernatant fluid was alkalized with ammonia to pH 8.5, the alkaloid fraction extracted thrice with 2 liters of chloroform. TLC, mass spectra and IR spectra were used to identify the compounds epicostaclavin, costaclavin, kanoclavin and isokanoclavin. Figures 4; references 16: 3 Russian, 13 Western.
[138-6508]

UDC: 577.153:632.95.024.2

STEREOSPECIFICITY OF ACTION OF THIOORGANOPHOSPHORUS AMINO ACID DERIVATIVES ON ESTERASE ACTIVITY OF COCKROACH NERVOUS TISSUE

Moscow PRIKLADNAYA BIOKHIMIYA I MIKROBIOLOGIYA in Russian Vol 17, No 6, Nov-Dec 81 (manuscript received 23 Feb 81) pp 927-932

SUNDUKOV, O. V., GOLOVKINA, L. S., MASTRYUKOVA, T. A., SHIPOV, A. E. and KABACHNIK, M. I., All-Union Institute of Plant Protection, Leningrad; Institute of Heteroorganic Compounds imeni A. N. Nesmeyanov, USSR Academy of Sciences, Moscow

[Abstract] A study is made of the influence of the absolute configuration of asymmetrical centers at phosphorus atoms and carbon atoms in derivatives of thiophosphoric and methylthiophosphoric acids on the esterase activity in the nervous tissue of the American cockroach Periplaneta americana L. Nerve chain homogenates were used for electrophoretic separation of the esterases. Isomers of the following compounds were studied for influence on the activity of individual types of esterases from the nerve ganglia of the American cockroach: 1) a derivative of O-ethylmethylthiophosphoric acid with a glycine group containing an asymmetrical phosphorus atom; 2) a derivative of O,Odiethylthiophosphoric acid with a valine group and asymmetrical carbon atom in the amino acid portion of the molecule; 3) O-ethylmethylthiophosphonate containing a valine ethylester group with asymmetrical phosphorus and carbon atoms. Isomers of S-configuration at the phosphorus and R-configuration at the carbon atom should have the greatest insecticidal activity of all diasteromer compounds similar in structure. The varying sensitivity of individual molecular forms of carboxylesterase in cockroach nervous tissue to the inhibiting influence of the isomer studied indicates stereospecificity of the active molecular surface in certain isoenzymes of this enzyme. Figure 1; references 21: 10 Russian, 11 Western. [138-6508]

UDC: 577.1

PHOSPHOLIPIDS AS STRUCTURAL ELEMENTS OF NUCLEAR MATRIX

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 3, Mar 82 pp 730-733

ALESENKO, A. V., KRASIL'NIKOV, V. A. and BOYKOV, P. Ya., Institute of Chemical Physics, USSR Academy of Sciences, Moscow

[Abstract] Studies were conducted on the hepatic nuclei of outbred albino rats to further characterize and define the nature of the phospholipid element of the nuclear matrix. Quantitative comparisons of the components present in the salt extracts of chromatin and of those in the extract additionally treated with heparin showed the presence of phosphatidylcholine, phosphatidylethanolamine, sphingovyelin, phosphatidylinositol,

phosphatidylserine, cardiolipin + phosphatidic acid, and lysophosphatidylcholine. Tentative conclusions were reached as to the significance of lipids in the template activity of chromatin, in that they are involved in the points at which DNA replication is initiated. References 14: 2 Russian, 12 Western.
[256-12172]

UDC: 576.858.23

NUCLEOSIDE DI- AND MONOPHOSPHATES AS SUBSTRATES IN RNA SYNTHESIS BY REPLICATIVE COMPLEXES OF ENCEPHALOMYOCARDITIS VIRUS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 3, Mar 82 (manuscript received 26 Oct 81) pp 734-737

KUNIN, Ye. V. and AGOL, V. I., Moscow State University imeni M. V. Lomonosov; Institute of Poliomyelitis and Viral Encephalitides, USSR Academy of Medical Sciences, Moscow

[Abstract] Investigations on the RNA polymerase complexes (replicative viral complexes, RVC) of the encephalomyocarditis virus in Krebs II ascitic caricinoma cells demonstrated that these complexes contain nucleotide kinases utilizing nucleoside di- and monophosphates as substrates. Furthermore, nucleosidemonophosphate kinase (I) appears to be bound much more strongly than nucleosidediphosphate kinase (II) to RVC. The essential function of I and II appears to be to provide sufficiently high ATP levels in virus-infected cells to assure a high rate of viral RNA synthesis by the RVC, since it has been established that during intense synthesis of single-stranded viral RNA the levels of ATP become depleted while those of ADP and AMP remain relatively constant in the case of the picorna viruses. This communication appears to be the first report demonstrating the presence of nucleotide kinases in RVC. Figures 4; References 13: 2 Russian, 11 Western.
[256-12172]

UDC: 577.158+661.185.223

SUBSTRATE SPECIFICITY OF ALCOHOL DEHYDROGENASE IN COLLOID AQUEOUS SOLUTION IN ORGANIC SOLVENT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 3, Mar 82 (manuscript received 16 Oct 81) pp 737-741

MARTINEK, K., KHMEL'NITSKIY, Yu. L., LEVASHOV, A. V., and BEREZIN, I. V., corresponding member, USSR Academy of Sciences Moscow State University imeni M. V. Lomonosov

[Abstract] The substrate specificity of alcohol dehydrogenase (ADH) solubilized in the sodium salt of di-(2-ethyl)-hexyl ester of sulfosuccinic acid and prepared as a colloid in octane was investigated with respect to a

series of aliphatic alcohols. Evaluation of the results in terms of the Michaelis constant showed that octanol was the optimum substrate in aqueous solutions and butanol in the emulsion. The change in substrate specificity was ascribed to local effects of the alcohol concentration on the ADH in the micelle. The emulsion model may more accurately reflect actual in vivo situations in biological membranes, and suggests that determinations of substrate specificities in vitro aqueous conditions should be evaluated more carefully in light of the present observations. Figures 1, references 13: 4 Russian, 9 Western.
[256-12172]

UDC: 614.57:615.285.7

CHROMATOGRAPHIC ASSAY OF TRICHLOROMETAPHOS-3 IN GRAIN

Moscow GIGIYENA I SANITARIYA in Russian No 11, Nov 81 (manuscript received 23 Jun 81) pp 48-49

KISELEVA, N. I. and KOBYLINSKAYA, L. I., All-Union Scientific Research Institute of Hygiene and Toxicology Pesticides, Polymers and Plastics, Kiev

[Abstract] A thin-layer chromatographic method was developed to determine the residual presence of trichlorometaphos-3 in wheat in storehouses. The method is based on extracting the preparation from the grain with acetone, purifying the extract of vegetable waxes by freezing and determining the preparation in a thin layer of silica gel. The localization zones of trichlorometaphos-3 are determined with a solution of silver nitrate and ammonia in acetone with subsequent irradiation by ultraviolet light. The minimum detectable quantity of trichlorometaphos-3 on Silufol-254 plates was 0.5-1.0 microgram and the minimum detectable quantity in a layer of KSK silica gel was 2-3 micrograms. The permissible residual quantity of trichlorometaphos in grain is 0.5 milligram per kilogram. The method is selective in the presence of pesticides used for moist disinfection of grain storehouses. References 4 (Russian).
[110-6521]

UDC: 615.918:582.282].074+614.31:615.918.582.282]-074

METHODS FOR ANALYZING APHLATOXINS

Moscow GIGIYENA I SANITARIYA in Russian No 11, No 81 (manuscript received 30 Jan 81) pp 49-53

TUTEL'YAN, V. A., ELLER, K. I. and KRAVCHENKO, L. V., Institute of Nutrition, USSR Academy of Medical Sciences, Moscow

[Abstract] Methods of analyzing aphlatoxins are being conducted in two directions: development of highly sensitive and highly specific chemical

methods of analysis and searching for convenient biological tests to detect aphlatoxins. Biological methods are usually of low sensitivity and highly specific and most of them require long time expenditures. The main steps of chemical analysis of aphlatoxins include production of a representative specimen and preparation of it for analysis, extraction of the aphlatoxins from the specimen to be analyzed, purification of the extract, separation, detection and quantitative determination of aphlatoxins and the use of tests that confirm the presence of aphlatoxins. A general scheme (flowchart) for chemical analysis of aphlatoxins is presented. The tests are used to determine the presence of aphlatoxins in food products in quantities corresponding to or less than the maximum permissible concentration, which is 5 micrograms per kilogram for aphlatoxin B_1 in most countries. Figures 1; references 13: 1 Russian, 12 Western.
[110-6521]

UDC: 591.185.3

FUNCTIONAL CHARACTERISTICS OF CHEMORECEPTOR SYSTEMS

Leningrad ZHURNAL EVOLYUTSIONNOY BIOKHIMII I FIZIOLOGII in Russian
Vol 17, No 5, Sep-Oct 81 (manuscript received 14 Apr 81) pp 455-460

MINOR, A. V., Laboratory of Morphology and Ecology of Higher Vertebrates, Institute of Evolutionary Morphology and Ecology of Animals imeni A. N. Severtsov, USSR Academy of Sciences, Moscow

[Abstract] A survey is presented of the biological significance in vertebrates and invertebrates of chemoreception in responsiveness to environmental conditions. The hypothesis is advanced that the taste modality subserves detection of nutrients, metabolites, and potentially toxic substances, while olfaction is reserved for the perception of pure signals in the form of gaseous, liquid, or solid chemicals. All other functions of these two chemoreceptor systems are regarded as of secondary importance. In comparison with taste, the olfactory system is characterized by high sensitivity and specificity. Particular attention is accorded to pheromone perception in chemical communication with its evolutionary and genetic basis. Subsequent evolutionary development of visual and acoustic perception complemented olfaction and eventually assumed a more importance role in many cases. Nevertheless, olfaction remains an important factor at virtually every evolutionary level. References 28: 6 Russian, 22 Western.
[152-12172]

UDC: 591.481.42:595.799

IDENTIFICATION OF DEUTEROCEREBRUM GLOMERULI IN HONEY BEE APIS MELLIFERA

Leningrad ZHURNAL EVOLYUTSIONNOY BIOKHIMII I FIZIOLOGII in Russian
Vol 17, No 5, Sep-Oct 81 (manuscript received 12 May 80) pp 480-485

FRANTSEVICH, L. I. and KOROBOVA, V. M., Institute of Zoology, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] The olfactory lobe of the Apis mellifera honey bee was subjected to serial histologic sectioning for identification of the deuterocerebral glomeruli. An analysis of 141 $\pm$ 1 glomeruli led to the identification of 8 individual glomeruli and approximately 55 glomerular groups as to their shape, location, and relation to established morphological markers; these were then classified and mapped with alphanumeric designations. Veriability was quite limited, in accordance with the constancy of neural structures in general. Figures 1; references 23: 1 Polish, 4 Russian, 18 Western.
[152-12172]

UDC: 591.185.6

ROLE OF CELLULAR ORGANOIDS IN PHOTORECEPTOR OPTICS (STUDIES ON SUPERHIGH FREQUENCY MODELS)

Leningrad ZHURNAL EVOLYUTSIONNOY BIOKHIMII I FIZIOLOGII in Russian
Vol 17, No 5, Sep-Oct 81 (manuscript received 20 May 81) pp 492-497

GOVARDOVSKIY, V. I., GOLOVANEVSKIY, E. I., ZUYEVA, L. V. and VASIL'YEVA, I. L., Institute of Evolutionary Physiology and Biochemistry imeni I. M. Sechenov, USSR Academy of Sciences, Leningrad, Leningrad Electrotechnical Institute imeni V. I. Ul'yanov (Lenin)

[Abstract] In order to assess the role of light-focusing formations on the optical characteristics of photoreceptors, 15,000: 1 scale styrofoam models were constructed of the external rod segments and cones with (for sturgeons, reptiles, birds, etc.) and without an oil droplet (for mammals and teleosts). Using 5.66-8.33 mm radiowave beams (ca. 15,000 X the light waves in the visible spectrum) 0.4-0.7 μm) it was revealed that the function of the focusing structures is to narrow directional sensitivity of the photo-receptors, attenuate the effects of scattered light, and increase the focal depth. Increase in sensitivity is obtainable only with small pupillary diameters; when the pupil diameter is that prevalent during dark adaptation, there is virtually no gain in sensitivity. Figures 4; references 13: 2 Russian, 11 Western.
[152-12172]

UDC: 591.185.2:595.729

FUNCTIONAL ORGANIZATION OF CERCAL MECHANORECEPTOR SYSTEM IN LARVAE AND IMAGO STAGES OF GRYLLUS BIMACULATUS CRICKET

Leningrad ZHURNAL EVOLYUTSIONNOY BIOKHIMII I FIZIOLOGII in Russian
Vol 17, No 5, Sep-Oct 81 (manuscript received 7 Apr 81) pp 503-511

KNYAZEV, A. N. and POPOV, A. V., Institute of Evolutionary Physiology and Biochemistry imeni I. M. Sechenov, USSR Academy of Sciences, Leningrad

[Abstract] Electrophysiological studies were conducted on the functional organization of the cercal mechanoreceptor system in the first larval and the imago stages of the cricket Cryllus bimaculatus. The results showed that each of the filiform sensillae was positioned in a preferential plane of vibration which is asymmetrical relative to the equilibrium position. Measurement of the electrical activities of individual sensillae showed that deflection of a hair in the preferred direction by up to 15° resulted in activation of receptor cells, while deflection in the opposite direction by up to 5° inhibited mechanoreceptor impulses. The directional sensitivity of the individual sensillae and their grouping into eight longitudinal zones accounts for the directional sensitivity of the entire cercal system. The direction of a stimulus induces activation and inhibition in the different mechanoreceptors subserving the left and right cerci, followed by presumed integration of the dicercal information at more central formations. The increasing efficiency of this system with age is indicated by the fact that in the first larval stage there are fewer cercal sensillae (55) than in the imago stage (820) and the fact that the fibers lengthen (from 421 to 3005 μm). Figures 3; references 22: 10 Russian, 12 Western.
[152-12172]

UDC: 591.185.6:597.5

ORIENTING LINE DETECTORS IN VISUAL SYSTEM OF CRUCIAN CARP CARASSIUS CARASSIUS

Leningrad ZHURNAL EVOLYUTSIONNOY BIOKHIMI I FIZIOLOGII in Russian Vol 17, No 5, Sep-Oct 81 (manuscript received 6 Apr 81) pp 519-525

MAKSIMOVA, Ye. M. and MAKSIMOV, V. V., Institute of Information Transfer Problems, USSR Academy of Sciences, Moscow

[Abstract] Electrophysiologic studies on the optic tectum of the crucian carp Carassius carassius revealed stratification in terms of electrical responsiveness and, in particular, that the lower part of the second layer (ca. 120 μm from the tectal surface) contained detectors yielding short triphasic impulses characteristic of the terminal branches of the ganglion cell axons (and completely unlike the low frequency impulses characteristic of tectal neurons). Detailed studies on detectors responding to vertical boundaries showed that responsiveness is enhanced by vertical movement, and

that horizontal fields and boundaries inhibit such tectal detectors. Rotation of the vertical stimuli 45° in either direction abolished responsiveness. Further rotation to 90° inhibited the vertical detectors but stimulated horizontal boundary detectors. Both types of detectors were unresponsive to color. The data were interpreted to indicate that two different types of ganglion cells were involved in the resolution of the retinal image into two orthogonal components prior to further processing of the visual signal, and that image analysis in this species commences at the retinal level, i.e., about four synaptic relays earlier than in mammals. Figures 3; references 22: 1 Bulgarian, 9 Russian, 12 Western.
[152-12172]

UDC: 632.937.12

AMBLYSEIUS LONGISPINOSUS (EVANS) (PARASITIFORMES, PHYTOSEIIDAE): PROMISING PREDATORY MITE FOR BIOLOGICAL CONTROL

Kiev VESTNIK ZOOLOGII in Russian No 5, Sep-Oct 81 (manuscript received 8 Jun 81) pp 78-81

AKIMOV, I. A. and KOLODOCHKA, L. A., Institute of Zoology, Ukrainian Academy of Sciences

[Abstract] Some results are presented from work performed in 1978-1979 in southern Sakhalin and on Kunashir Island, a part of a long term study to seek promising acariphages for biological plant protection. Amblyseius longispinosus (Evans) was selected from 16 mites tested as the most aggressive against the common spider mite, and also for its rapid breeding properties. A. longispinosus was found to have good control effects against various tetranychus species under field conditions, and was also found to be tolerant to a broad range of temperature conditions. A. longispinosus most actively consumes immature stages of tetranychus, making it particularly effective in preventing rapid increases in tetranychus populations. Its use is recommended for greenhouse conditions. Figure 1; references 8: 7 Russian, 1 Western. [164-6508]

UDC: 575.1:576.851.48

R-PLASMID MEDIATED CHROMOSOMAL CONJUGATIONAL GENE TRANSFER IN BACTERIUM ERWINIA

Moscow GENETIKA in Russian Vol 17, No 9, Sep 81 (manuscript received 27 Jun 80) pp 1600-1605

PESNYAKEVICH, A. G., LOBANOK, T. Ye. and FOMICHEV, Yu. K., Minsk Reference Point, All-Union Scientific Research Institute of Genetics and Selection of Industrial Microorganisms

[Abstract] An attempt is made to determine the capacity of a number of known R factors to transfer chromosomal Erwinia genes. The results produced indicated that Rts1::Tn10/707 plasmids take part in chromosomal gene transfers

in the strain studied. However, if the plasmid is transmitted from bacteria of the strain Erwinia 106-7 (2-7) to cells of the strain Erwinia 106-7 wild, they are transformed to effective donors only of the received plasmid and cannot transmit the chromosomal genes. Therefore the capability of the Rtsl::Tnl0/707 factor to mobilize chromosome transfer appears only in cell clones formed in the process of growing the strain at elevated temperatures, which preserve the plasmid. It is predicated that the site of interaction is localized in a certain area of the chromosome, determining the sequence of gene transfer upon conjugation. The selection of cells in which it is relatively easy to perform temporary interaction of the R plasmid with the chromosome probably resulted from growth of the Erwinia bacteria at the elevated temperature of 42°C. References 14: 4 Russian, 10 Western.
[137-6508]

UDC: 598.422.1:591.65

ECOLOGICAL AND TECHNICAL ASPECTS OF BIOACOUSTICAL SCATTERING OF BLACK HEADED GULLS

Moscow ZOOLOGICHESKIY ZHURNAL in Russian Vol 61, No 1, Jan 82
(manuscript received 17 Feb 81) pp 90-94

BEKLOVA, M., PIKULA, I. and YAKOBI, V. E., Institute of Zoology of Vertebrates, CSSR Academy of Sciences, Brno; Institute of Evolutionary Morphology and Ecology of Animals, USSR Academy of Sciences, Moscow

[Abstract] Three types of installations were tested in the vicinity of the Brno airfield to frighten away black headed gulls (Larus ridibundus), involved in 75% of bird-aircraft collisions in the USSR. The area studied in the USSR was the Baltic region. Alarm cries of young black headed gulls were magnetically recorded, then reproduced in the vicinity of the airfield either continuously or at intervals of 3 seconds. Three types of installations were used: two 25-watt speakers on the roof of a vehicle, a 10-watt speaker on the roof of a vehicle and a 200-watt mobile speaker installation powered by a gasoline generator. The experiments were performed at the city dump near the airport, in a meadow and in a nesting area. The alarm cries were reinforced by firing of signal rockets with explosive charges. The most effective procedure was found to be reproduction of alarm cries, which attracted the birds toward the source of the sound, followed by bursting of a loud powder charge in a rocket, which caused the birds to disperse. The only exception was the nesting area, in which none of the signal versions used was very effective in frightening away the birds. References 6: 5 Russian, 1 Western.
[181-6508]

UDC: 547.963.3

SYNTHESIS AND CLONING OF DNA COMPLEMENTARY TO RABBIT GLOBIN PRE-mRNA

Moscow MOLEKULYARNAYA BIOLOGIYA in Russian Vol 16, No 1, Jan-Feb 82
(manuscript received 28 Jun 81) pp 47-54

ZOLOTUKHIN, S. B., ISHCHENKO, I. D., STAVERSKAYA, O. V., RYNDICH, A. V. and KAVSAN, V. M., Institute of Molecular Biology and Genetics, Ukrainian Academy of Sciences, Kiev

[Abstract] The true boundaries of a transcription unit for globin are not known. Scientists also do not know whether there are strict transcription frameworks for eukariotic genes, nor how the processing of the precursor of pre-mRNA, the substrate for final splicing, occurs. The authors suggest a new approach to the study of the specifics of splicing, consisting of studying, not the pre-mRNA molecules themselves, but rather their DNA copies synthesized by reverse transcriptase. Later cloning of such double helix molecules in bacterial plasmids allows a great number of individual DNA molecules to be obtained, each of which is a copy of one pre-mRNA molecule at some stage in processing. Reverse transcription under optimal conditions and extraction with hot phenol produced full sized representative DNA copies. Special precautionary measures were taken to safeguard the preparations, including conducting all experiments at 2°C, adding diethylpyrocarbonate to all solutions to inhibit RNAase and the use of gel filtration to eliminate any possible RNAase impurity. Globin sequences were identified by hybridization in situ with colonies of $Ap^{8}Tc^{r}$, 86 of 360 colonies yielding a positive response in the hybridization reaction with DNA complementary to mRNA of the rabbit globin. A photomicrograph is presented showing that the recombinant clones produced yield clear positive signals. Figure 1; references 30: 3 Russian, 27 Western.
[180-6508]

UDC: 547.962

A PRIORI COMPUTATION OF THREE-DIMENSIONAL STRUCTURE OF NEUROTOXIN: Leu^{1}-Cys^{23} FRAGMENT

Moscow MOLEKULYARNAYA BIOLOGIYA in Russian Vol 16, No 1, Jan-Feb 82
(manuscript received 10 Sep 80; after revision, 23 Mar 81) pp 129-141

ZAVAL'NYY, A. A. and POPOV, Ye. M., Institute of Bioorganic Chemistry imeni M. M. Shemyakin, USSR Academy of Sciences, Moscow

[Abstract] Results are presented from the first a priori computation of the three-dimensional structure and conformational possibilities of the protein molecule neutrotoxin II containing 61 amino acid groups. Calculation was based on a system suggested by one of the authors allowing prediction of the

native conformation of protein based on the known amino acid sequence. The theoretical structural analysis of the neurotoxin molecule was performed in several stages, the first four of which consisted of studying the conformational capabilities of free protein segments. Each of these in turn included the solution of a number of conformational problems for the components of the fragments. The fifth and sixth stages involved analysis of the conformation of two parts of the protein sequences, while the seventh stage involved spatial construction of the entire molecule. The computation showed that spontaneous formation of the disulfide bond is the basis of the conformational aspects. Valent bonding of cysteines is preceded by the formation at one end of the fragment of a conformationally rigid nucleation, at the other, shorter end - a labile section. The two different sections perform different functions which are necessary for the process to be completed rapidly, spontaneously and accurately. Nucleation causes this to be a deterministic rather than statistical process. Figures 4; references 26: 7 Russian, 19 Western.
[180-6508]

UDC: 577.37

OPTIC TECHNIQUES FOR STUDYING NEURON STRUCTURES

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 16 Mar 81) pp 4-21

SUYUSHEV, V. A., FEDOSEYEV, V. P. and SHTARK, M. B., Novosibirsk

[Abstract] A detailed, and to a great extent chronological, review is presented on the use of optic techniques in research on excitable membranes. The use of optic techniques is increasingly becoming a viable alternative to traditional techniques such as use of microelectrodes in the fields of neurobiophysics and neurophysiology, particularly if the optic techniques are used on line with computers. Various properties of excitable membranes, including transmembrane potentials, ion currents, postsynaptic potentials and action potentials, have been studied by these techniques in vertebrates and invertebrates. Birefringence, light scattering, use of lasers, turbidity, light absorption, dichroism, fluorescence, use of potential-dependent stains, use of molecular probes and use of heat-sensitive liquid-crystal probes (filled, for example, with cholesterol esters) are reviewed. Technical requirements for optic methods and problems associated with their use are also discussed. Figures 7; references 60: 19 Russian, 51 Western.
[184-9307]

UDC: 612.014.412:577.352.3

TECHNIQUES FOR STUDYING ION CHANNELS IN EXCITABLE MEMBRANES

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 16 Feb 81) pp 22-28

BENDUKIDZE, Z. A., ZIL'BERTER, Yu. I. and TIMIN, Ye. N., Moscow

[Abstract] The possibilities are analyzed of using modern techniques for studying ion permeability and of electronic and computer requirements for obtaining accurate measurements. The technique of potential fixation was used based on developing a special electronic circuit representing an excitable membrane. A two-electrode system is described for single cells and a three - electrode system for studying membrane ion currents in whole tissue (e.g., heart, muscles). Mathematical equations representing both systems are derived. The measuring unit in such systems should be able to resolve current signals with an amplitude of 10^{-13} A and frequency of 10^4 Hz. A computer should be used as a recorder; available systems are based on mini- and micro-computers, which make it possible to control the experiment (digital-to-analog converter) and to record signals with adequate resolution (analog-to-digital converter). A high-level processor for obtaining results from preliminary processing in real time with a large memory capacity is an essential feature. Figures 3; references 13: 2 Russian, 11 Western.
[184-9307]

UDC: 612.014.412:577.352.3

POSSIBILITIES OF STUDYING ION CURRENT KINETICS DURING SPIKE BY POTENTIAL FIXATION

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 16 Jan 81) pp 28-31

KHICHENKO, V. I., Novosibirsk

[Abstract] Equations are derived for calculating ion currents flowing through membrane channels. Current flowing through a membrane, when the current of specific channels is eliminated and a signal identical to the previously recorded action potential is used as the command, is equal to the modulus of ion current flowing through these channels during normal spike generation. This holds if the elimination of the current does not alter other ion currents. An experiment on determining ion current kinetics during action potential generation in a mollusk somatic membrane is presented as an example. Ion currents may be studied during rhythmic neuron activity, if a series of previously fixed spikes is used as the command signal. References 9: 4 Russian, 5 Western.
[184-9307]

UDC: 612.8

MODEL OF LOCAL CONDITIONED REFLEX ON PLASTIC NEURONAL NETWORK

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 20 Jan 81) pp 31-39

FROLOV, A. A. and KHARITONOV, A. P., Moscow

[Abstract] The capacity of a neuronal network to retain information during variations in reactivity is analyzed on a model of simple memory. The network consisted of three layers of neuronal elements (afferent, associative and efferent) with a random relationship. In essence, the model was an example of applying a stochastic quasiholographic approach to studying memory. The number of binary plastic elements in a stochastically organized quasiholographic network in a simple-memory network was several times higher than the limit established by information theory. The method used in constructing the neuronal network produced a minimal excess of the required number of plastic elements in comparison with the ideal case. The analysis of the network in which elevated neuron reactivity was selected as the plasticity mechanism revealed that this frequent physiological phenomenon may be a basis for learning which is as effective as synaptic plasticity. Figures 4; references 18: 12 Russian, 6 Western.
[184-9307]

UDC: 612.822.3.087

METHOD FOR DETECTING LOCAL NONUNIFORMITIES IN FIELD OF BRAIN BIOPOTENTIALS

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 22 Dec 80) pp 39-48

TSITSEROSHIN, M. N., Leningrad

[Abstract] A method for analyzing local nonuniformities in a field of brain biopotentials, which was useful in studying spatial-temporal EEG characteristics, is further discussed, specifically with regard to EEG intensities and their correlations. A summation correlation coefficient (SCC) is derived which incorporates information on mutual-correlation and amplitude relationships of fluctuations in biopotentials from different areas of the brain; SCC is the average sum of all correlation coefficients for processes occurring at a specific point relative to other points within the field and has the range of -1 to +1. The SCC for EEGs may be calculated by digital computer and analog correlators. Several extreme situations for calculating SCCs are presented, which include independent, single synpasic and antiphasic processes. Graphs of SCCs are presented for alert subjects with closed or open eyes, sleep stages II-IV and paradoxical sleep. The SCC graphs for each condition were determined primarily by correlation or intensities on the EEGs

for different regions of the biopotential field. SCCs for a patient with toxemia of pregnancy illustrated how this method can be used to obtain information on dominant relationships between the activities of homologous zones in the right and left hemispheres. The patient's EEG exhibited marked hemispheric asymmetry in SCC values, which normalized as the patient's condition improved. Figures 3; references 10: 4 Russian, 6 Western.
[184-9307]

UDC: 519.24:612.8

STATISTICAL PATTERNS IN SINGLE NEURON BACKGROUND SPIKE ACTIVITY

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 16 Jan 81) pp 49-60

KULIKOV, M. A., Moscow

[Abstract] A procedure is described for the statistical analysis of background spike activity (BSA) of pyramidal tract neurons in cats for a quantitative description of variations in its structure in relation to type and degree of anesthesia (hexenal, chloralose). Stable tracings of BSA were obtained for 54 neurons; regions of stability lasted from 53 to 540 s and there were 139-3218 interspike intervals (ISI) in these regions. Histograms of ISIs in stable regions were bimodal or trimodal. Of 50 numerical characteristics, 26 were informative for subdividing the tracings in relation to anesthesia. Four basic types of tracings were isolated. The relationship between tracing type and type and extent of anesthesia was analyzed on the basis of group-batch activity and by correlational spectral analysis of ISI sequences and time of spike appearance. Neuron activity in an alert state and under light anesthesia is described. Figures 4; references 16: 11 Russian, 5 Western.
[184-9307]

UDC: 681.3.068+61.007:61

GENERATION OF SOFTWARE FOR BIOMEDICAL EXPERIMENTS USING SM-3 TYPE MINICOMPUTER AND CAMAC HARDWARE

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 9 Mar 81) pp 60-69

SALAMATIN, I. M., SHTARK, M. B. and YANOVSKIY, G. Ya., Novosibirsk, Dubna

[Abstract] The nature of biomedical experiments requires highly flexible and readily modifiable systems for automated accumulation and analysis of experimental data. An approach is described to creating the software for a system based on an SM-3 minicomputer and CAMAC hardware used to produce

applied systems for specific biomedical studies. The system complex consists of a compiler, Assembler program, programs for library work (SANPO=software for producing and applied system of computerized accumulation and preliminary analysis of data in real time), and a problem-oriented complex of program modules, which do not depend on specific experimental procedures. The applied system includes a monitor program, subsystem for data analysis and for operations with experimental facilities in the standard CAMAC and a system overseeing the interaction of these components. A specific example is given in which this sytem analyzed the monitoring of human heart activity. A unique aspect of this approach to programming a computer on line with CAMAC hardware is the concurrent use of logic instructions for functional CAMAC blocks, unified structure of program modules, standard interface for data exchange and control between modules and routine programs, individual translation of program modules and generation of the applied system from modules. Figures 3; references 21: 17 Russian, 4 Western.
[184-9307]

UDC: 57.08+616.071:65.011

HARDWARE-SOFTWARE COMPLEX FOR STUDYING DYNAMICS OF HUMAN BRAIN NEURON ACTIVITY

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 20 Nov 80) pp 69-74

GOGOLITSYN, Yu. L., KAMINSKIY, Yu. L., KROPOTOV, Yu. D. and PAKHOMOV, S. V., Leningrad

[Abstract] A hardware/software complex was developed for studying neurophysiological mechanisms of psychological activity in humans; the complex makes it possible to record neuron activity concurrently in several (up to eight) channels, to show the patient sequences of visual stimuli in a set position and specific time intervals, to record verbal and motor activity and to analyze the dynamics of actual neuron frequency. The complex was based on the Plurimat-S system for signal analysis and consists of an amplifier and units for presenting stimuli and recording subject responses, as well as a magnetic tape recorder, a display unit and a unit for transforming neuron activity and sound signals. The programs enable the real-time transformation of recorded neuron activity into the actual frequency of neuron discharge and to transmit the data to the memory (magnetic disk) for subsequent off-line analysis. Figures 2; references 4 (Russian).
[184-9307]

UDC: 61.007:61:612.822

PROBLEM-ORIENTED COMPUTER COMPLEX FOR IDENTIFYING NONLINEAR BIOLOGICAL SYSTEMS

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 8 Jan 81) pp 75-80

ZAYTMAN, G. A., KOSITSKIY, N. N., PYATIGORSKIY, B. Ya., RUBASHOV, S. Yu., CHERKASSKIY, V. L. and CHINAROV, V. A., Kiev

[Abstract] A system is described for automating physiological studies, which, together with the statistical analysis of data, makes it possible to identify nonlinear physiological systems such as neurons. Algorithms for identifying individual units in the central nervous system are presented with a discussion of Volterra expansions and Wiener analysis. The hardware and software for a system for automating physiological studies (SAFI) capable of handling complex algorithms and of creating mathematical models of nonlinear systems while experiments are in progress, in addition to analyzing neurophysiological data, are described. The lower level of the computer system is based on an IVK-1, which consists of an SM-3 minicomputer and two CAMAC crates. Neuron electrical activity is monitored by micro- and macroelectrodes and entered in digital form after amplification as spike sequences. The upper level of SAFI is an M-4030 computer linked in series to the SM-3 through the interface unit A7118. FORTRAN IV was used for programming. Tests on simulated neuron models demonstrated that Wiener analysis seemed promising for modeling simple neuron networks. Further tests are underway on mollusk neurons. Figure 1; references 10: 4 Russian, 6 Western. [184-9307]

UDC: 577.352:61.007:612.822

COMPUTERIZED STUDY OF VOLT-AMPERE AND INACTIVATION CHARACTERISTICS OF ION CHANNELS IN NEURON MEMBRANES

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 24 Jan 81) pp 80-87

BUSH, A. V., GAYNUTDINOV, Kh. L. and KHICHENKO, V. I., Novosibirsk

[Abstract] Results are presented from neuron membrane studies in which a minicomputer--CAMAC system was used. Algorithms are presented for measuring membrane current and volt-ampere characteristics (VAC) of currents entering and leaving the membrane. The algorithms, together with programs and hardware, comprised an automated experimental system based on potential fixation. The devised system was tested in experiments on the functioning of neuron ion channels when membrane protein (antigen) activity was affected by antibodies. Giant neurons from snails and antibodies to snail neural tissue were used. Membrane potentials were measured by computer via microelectrodes; rest

potentials and VAC of entering and exiting currents were measured from -90 to +30 mV at 5 mV intervals. Neuron antiserum substantially reduced maximum conduction of the entering current and began to exhibit an effect within 1 min. Original characteristics were restored when antiserum was replaced by physiological solution. The automated system for studying ion current kinetics by potential fixation increased experimental efficiency; VAC for entering currents were obtained with 30 s. This system has the advantage in determining the entering current inactivation curve in that the test impulse is set by the experimentor from analyzing VAC obtained from the specific subject before the inactivation curve is plotted. Standard programs and the rapid determination of membrane characteristics facilitate the use of this system for screening biologically active substances at the neuron membrane level. Figures 5; references 10: 7 Russian, 3 Western.
[184-9307]

UDC: 681.3:612.172.2

SYSTEM FOR AUTOMATING STUDIES ON REFLEX SHIFTS IN HUMAN HEART RHYTHM DURING SHORT-TERM EFFECTS

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 21 Jan 81) pp 87-95

GEL'TSEL', M. Yu., DERIY, B. N., SHTARK, M. B. and SHUL'MAN, Ye. I., Novosibirsk

[Abstract] The system described for automating studies on reflex shifts in heart rhythms (SIRIUS) is based on a Saratov-2 minicomputer and CAMAC modules operating within a multicrate CAMAC system; this is a flexible system which can be modified further. Algorithms are programmed in Assembler language. Stimuli may be sound, light, signal for a certain motor response or squirting fluid on the subject. Measurement of reflex shifts in heart rhythm in the SIRIUS program was based on measuring the regularity of breathing-related changes in RR-intervals. Measuring poststimulus shifts in cardiac intervals with regard to breathing phase increases accuracy and makes it possible to compare reflex shifts in heart rhythm in various breathing phases. The system also provides for dialog between computer and researcher by means of a console with an alphanumeric display. A particular feature of this system is program control of stimulus sequences; the "action program" can contain commands to repeat any program section or to shift to a new section. Details are included on analyzing electrocardiosignals, calculating differences in cardiac intervals, data file organization, logging of experiments and stimulus control. Figures 5; references 9: 5 Russian, 4 Western.
[184-9307]

UDC: 612.8;61.007

AUTOMATED ANALYSIS OF ELECTROPHOREGRAMS IN NEUROPHYSIOLOGICAL LABORATORY

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 22 Jan 81) pp 96-104

BEREGOVOY, N. A., DERIY, B. N. and DERIY, L. V., Novosibirsk

[Abstract] A system was developed for the automated analysis of electrophoregrams (densitograms) used, for example, in analyzing proteins from different brain structures; the system in based on an IFO-451 series microphotometer, "Elektronika-60" microcomputer and CAMAC with an RT-11 (M400 computer) as the operational system. A crate controller was used to organize linkage between the microcomputer and test equipment. A standard TV screen was used for display; programs were written in Assembler and BASIC and computation programs in BASIC. Fourteen subprograms (external functions) were used. Algorithms for analyzing the electrophoregrams were based on dividing the electrophoregrams into fragments and calculating the area of fragments and their ratio to total area. Advantages of the described system are the use of widely available, inexpensive CAMAC and the simplicity of obtaining a single data bank for different experiments, which facilitates a more thorough study of cause-effect relationships in the structure and function of living systems. The single data bank also allows comparative analysis of densitograms as a three-dimensional image with various factors (functional state, brain section, etc.) as the third axis. Figures 5; references 13: 10 Russian, 3 Western.
[184-9307]

UDC: 150.72.002.5

AUTOMATION OF PSYCHOLOGICAL EXPERIMENT

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 10 Nov 80) pp 104-111

ALLIK, Yu. K., LUUK, A. G., and MIYL', M. Kh., Tartu

[Abstract] Unique aspects of psychological experiments (use of human subjects and consequent problems), recordable parameters (psychophysiological; motor and verbal responses) and features of computer systems of possible use in such experiments are discussed. An experimental system was designed and tested, which was based on the trunk--module principle for linkage with an "Elektronika D3-28" computer. The basis of the experimental system was a programmable interface operating in synchronous or asynchronous modes. The system was tested in an experiment in which eye movements of a human subject following a moving light were recorded. A program was developed for recording and analyzing eye movements with subprograms for system calibration,

correction and regulating the position of the mirrors used. Analysis of target and eye movements with calculation of mean error and cross correlation revealed that errors in following the target had a periodically recurring structure with greatest errors at every 60° when lateral deviation of the target was greatest. As target motion exceeded a certain speed, eye movements began to miss the higher harmonic components of target motion and followed the basic component. Figures 5; references 17: 13 Russian, 4 Western.
[184-9307]

UDC: 612.82:615.47

PROCEDURAL DATA FOR OBTAINING CLINICAL ELECTROENCEPHALOGRAPHIC RESULTS BY COMPUTER

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 16 Jan 81) pp 112-120

GURATH, B. and CAMMANN, H., Berlin, GDR

[Abstract] A method for the computer analysis of EEGs is presented, which uses an algorithm for analyzing EEG amplitudes and time intervals. Frequency, peak amplitude and EEG patterns were also incorporated. Because of the volume of data, data compression by several (e.g., three) in part independently operating computers in a multiprocessor system is proposed. An iterative analog computer is used in the first stage of data compression. Further EEG analysis is performed by a digital computer. The program covers all possible combinations of EEG parameters, even those without currently evident clinical value. Data are collected on a four-byte "telegram." A standard visual and computer evaluation of an EEG produced similar results. Figures 6; references 6: 3 East German, 3 Western.
[184-9307]

UDC: 612.17

AUTOMATION OF DATA ANALYSIS IN EXPERIMENTAL ELECTROPHYSIOLOGY

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 11 Dec 80) pp 121-126

BROEDEMANN, R., LINDENAU, L. and MATTIS, Kh. K., Magdeburg, GDR

[Abstract] Theoretical foundations are discussed of designing a system for collecting and analyzing data in an electrophysiological laboratory, in which evoked potentials and EEGs are studied. There are three basic stages in collecting and analyzing data: analysis during which specific indices are defined, quantitative analysis of data and biostatistics. A system is described, which includes an EC-1040 computer; Explorer III, a digital, two-channel oscilloscope with floppy-disk memory; analog magnetic storage; and

a PDP-12 small laboratory computer. Data are collected at three stations from the same type of experimental animal (e.g., Wistar rats). As an example, monosynaptic potentials from the hippocampus were obtained at one station and various parameters (latent periods, slope functions, amplitudes of population spikes) were calculated on the PDP-12. The system is also being used to study long-term potentiation in the hippocampus, its mechanisms and pharmacological modulation. Learning behavior and EEG data were obtained at other stations. The hierarchical structure of the system facilitates control over the equipment and assessment at various stages of data collection and analysis. The system is also adaptable for expansion. The introduction of a CAMAC system is planned. Figures 4; references 5: 2 East German, 3 Russian.
[184-9307]

UDC: 681.518.2:612.17

RECORDING OF TELEMETRIC DATA, THEIR ACCUMULATION AND COMPUTER ANALYSIS

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 8 Jan 81) pp 126-131

WITZKE, S., WOLTER, F., KOENIG, F. and SCHMIDT, R., Berlin, GDR

[Abstract] Two examples are described of using telemetric systems in medical research, which included off-line processing of continuous blood pressure (BP) in rhesus monkeys and ECG and BP in humans. An off-line program (PAL8) was used in the tests on rhesus monkeys. Arterial pressure was measured and transmitted by a battery-powered sensor. After being received, data were further analyzed by computer and stored on magnetic tape. The system incorporated a TPA 1001/i processor, CAMAC interface and peripheral equipment. A PAL8 (FORTRAN II) program was used for multichannel recording of BP and ECG during heart catheterization. Measurements of BP and cardiac indices are used to evaluate hypertension and treatment efficacy and to monitor recovery following myocardial infarction or hyptertension. Signals were measured on a three-channel telemetric system MEDITEL-150. Data were stored on tape, and magnetic disks were used as the intermediate memory. R waves, QRS complexes and R-R intervals were used as basic indices. Configurations of both systems are included. Figures 6; references 4: 2 East German, 1 Russian, 1 Western.
[184-9307]

UDC: 612.014.421:8:021.398

PSEUDORANDOM SIGNAL GENERATOR AS MODULE FOR STANDARD CAMAC

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 21 Jan 81) pp 131-132

KREKULE, I. and PEKAREK, O., Prague, Czechoslovakia

[Abstract] The performance of mini- or microcomputers, used in automating analysis of nonlinear biological systems, may be improved by peripheral units that perform various functions. The pseudorandom signal generator (PSG-3) described is a miniaturized and improved modification. Impulses (up to $1.048 \cdot 10^6$ impulses) may be generated internally, externally or called up by pressing a button. PSG-3 has two identical channels, one of which may be delayed for cross correlation. The length of the shift register and second-channel delay are manually controlled. Interaction with the crate trunk is also possible. Figure 1; references 5: 1 Czech, 4 Western.
[184-9307]

UDC: 616.89.007

STRUCTURAL APPROACH TO CLASSIFYING RHEOENCEPHALOGRAMS

Novosibirsk AVTOMETRIYA in Russian No 4, Jul-Aug 81 (manuscript received 18 Feb 81) pp 132-136

FROLOV, D. N., Tomsk

[Abstract] Automated analysis of biomedical data has become highly useful in public health and epidemiology, specifically in reference to cardiovascular diseases. A structural approach is described for classifying rheograms to differentiate rheographic indices for normal and pathological states. The initial description consisted of devising a two-level classification system: qualitative analysis of signal form and isolation of quantitative parameters. A total of 24 parameters were used including signal form, wave characteristics and diastolic and systolic indices. The block diagram of the algorithm is presented. The informativeness of the selected indices was tested by analyzing rheoencephalograms from 32 healthy subjects and 73 patients with hemodynamic disorders. Data were analyzed by an EC-1033 computer. The proposed descriptions were found to cover all types of rheograms. The proposed classifiers (method of standards and linear differentiating function using only the most informative indices) reduced the time for rheogram analysis while retaining depth of analysis. Figures 2; references 5 (Russian).
[184-9307]

UDC: 576.895.2:599.323.4

ECOLOGICAL RELATIONSHIPS OF INVERTEBRATES TO NESTS OF COMMON RED-BACKED VOLE

Leningrad PARAZITOLOGIYA in Russian Vol 16, No 2, Mar-Apr 82 pp 122-130

GOLOVACH, G. P., Institute of Zoology, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] The ecological relationships of some systematic groups and species of invertebrates were analyzed quantitatively in the nests of the common red-backed vole. Six different types of nests, including newly constructed, proliferous, post-proliferous, those prepared for wintering, wintering and post-wintering, were determined. The quantitative principles that express the degree of relationship of nidicols to the different types of nests show a predominance in proliferous nests during the warm season and in wintering nests during the cold season. The faunistic and quantitative affinity of fleas was highest in proliferous and post-wintering nests and in nests prepared for wintering and wintering nests. The dominant position among the nidicols was occupied by saprophages, followed by zoophages and faultative hematophages and obligate hematophages in all the investigated types of nests. Figures 2; references 13 (Russian).
[211-A-6521]

UDC: 576.895.771(477.71)

FECUNDITY OF FEMALES OF MANSONIA RICHIARDII (CULICIDAE) IN SPHERE OF INFLUENCE OF KAKHOVKA RESERVOIR

Leningrad PARAZITOLOGIYA in Russian Vol 16, No 2, Mar-Apr 82 pp 131-135

GOZHENKO, V. A., Zaporzh'ye Medical Institute

[Abstract] The dependence of the fecundity of females of Mansonia richiardii on body weight, linear dimensions of the specimen, amount of ingested blood, supplementary carbohydrate feeding and the physiological age of the females was investigated in the area of the Kakhovka Reservoir. A direct dependence on the body weight and linear dimensions of the specimen was found to affect

potential fecundity. Actual fecundity shows a close positive relationship to the amount of ingested blood and is dependent on supplementary carbohydrate feeding and the physiological age of the female. The minimum ecological fecundity comprises 32 eggs, while the maximum fecundity comprises 252 eggs throughout the life of the species, while the lifetime fecundity of females of M. richiardii was 381 eggs. References 13: 9 Russian, 1 Czech, 3 Western.
[211-A-6521]

UDC: 576.895.771(470.68)

BLOOD SUCKING MOSQUITOS (CULICIDAE) THAT FEED ON HUMANS IN REGION OF EASTERN MANYCH (KALMYTSKAYA ASSR)

Leningrad PARAZITOLOGIYA in Russian Vol 16, No 2, Mar-Apr 82 pp 163-165

SAVITSKIY, B. P., Gomel' State University

[Abstract] The 13 species and subspecies of blood sucking mosquitos that feed on humans in the region of the Eastern Manych are listed and their areas of habitation are given. The dominant species that affect humans are Aedes caspius caspius, Aedes vexans and Kulex modestus, comprising 34.2, 27.2 and 13.1 percent, respectively, of the collected mosquitos. Anopheles maculipennis, Kulex pipienes pipienes and Mansonia richiardii are comparatively numerous in the area. The remaining species are sparse or are found only in single specimens. Anopheles algericus, Uranotaenia unguiculata, Culiseta longiareoleta and Culiseta annulata were described for the first time in the area of collection. The investigation shows a total of 19 species and subspecies of blood sucking mosquitos in the Kalmytskaya ASSR. References 7 (Russian).
[211-A-6521]

UDC: 576.895.775:614.449

EFFECT OF DENDROBACILLIN ON FLEAS OF XENOPSYLLA CHEOPIS (SIPHONAPTERA)

Leningrad PARAZITOLOGIYA in Russian Vol 16, No 2, Mar-Apr 82 pp 165-168

YERSHOVA, L. S., AFANAS'YEVA, O. V. and BUNDZHE, A. F., Central Asian Scientific Research Antiplague Institute; Kazakh Institute of Plant Protection, Alma-Ata

[Abstract] The effect of the bacterial preparation dendrobacillin on the laboratory population of fleas of Xenopsylla cheopis was investigated under experimental conditions and was compared to the addition of minimum doses of DDT and Sevin. The presence of 10-30 mg/g of dendrobacillin caused the

death of 51-83 percent of the imagoes and 60-72 percent of larvae under laboratory conditions. Addition of 0.02-0.06 mg/g of Sevin to the dendrobacillin preparation resulted in 100 percent death of all stages of fleas. A mixture of 10-20 mg/g of dendrobacillin and 0.02 mg/g of DDR caused the death of up to 92-94 percent of adult fleas. Sevin in combination with dendrobacillin showed more effective control than DDT in combination with dendrobacillin. References 8 (Russian).
[211-A-6521]

UDC: 595.7:576.12:001.1

BASIC FACTORS IN FORMATION AND EVOLUTION OF LARGE GROUPS OF INSECTS

Moscow ZHURNAL OBSHCHEY BIOLOGII in Russian Vol 42, No 4, Jul-Aug 81 (manuscript received 15 Jul 80) pp 485-491

KRYZHANOVSKIY, O. L., Institute of Zoology, USSR Academy of Sciences, Leningrad

[Abstract] The question of evolutionary factors during which broad profile adaptations occurred has been little studied. These adaptations have greatly expanded the capabilities for utilization of environmental resources and thus lead to biological progress, facilitating highly energetic adaptive radiation and development of high rank taxons, orders, suborders and large families. This category of evolutionary process is particularly interesting for systematic zoologists. Its understanding requires an analysis of factors which determine the evolution of large groups. It is found that their development generally follows the course of allogenesis, while their further evolution and adaptive radiation follow the course of telegenesis. Examples are presented to demonstrate that for each of the large taxons it is possible to establish the factors which served as prerequisites for the allogenetic evolution of the taxon, causing the expansion of its evolutionary capabilities and thus its biological progress and adaptive radiation. It is possible in principle to determine the basic factors in allogenesis which in each individual case have led to the development of most of the large systematic groups at the family or order level. Therefore analysis of allogenesis factors is an important condition for an understanding of the evolution of such taxons. References 14 (Russian).
[153-6508]

UDC: 616-936.88(575.1)+616.127-005.8-036.88

RESULTS AND PROSPECTS OF STUDY OF SUDDEN DEATH IN UZBEKISTAN

Tashkent MEDITSINSKIY ZHURNAL UZBEKISTANA in Russian No 4, Apr 81 (manuscript received 21 Jan 80) pp 32-36

TULYAGANOV, P. D., YULDASHEV, K. Yu. and GIYASOV, Z. A., Department of Pathologic Anatomy, Cardiology and Functional Diagnosis, Tashkent Institute for Advanced Training of Physicians and Forensic Medicine, Tashkent Order of Labor Red Banner Medical Institute

[Abstract] The frequency of sudden death syndrome is increasing from year to year. Tables are presented indicating the frequency of sudden death in Uzbekistan as a function of season of year, sex and age of victims, cause as revealed by autopsy and cardiovascular pathology in those cases (75%) of sudden death which result from cardiovascular disease. The authors agree that meteorological factors, changes in atmospheric pressure and solar activity influence sudden death frequencies. Climate, immunologic changes in the organism and physical-emotional stress are named as primary factors in the development of sudden death syndrome. References 10: 7 Russian 3 Western.
[163-6508]

UDC: 616.24-006.6(47 + 57 + 87)

PRESENT STATUS OF TRENDS IN INCIDENCE OF LUNG CANCER AND LETHALITY FROM IT IN USSR AND ABROAD

Leningrad VOPROSY ONKOLOGII in Russian Vol 28, No 2, Feb 82 pp 15-18

MERABISHVILI, V. M., TSERKOVNYY, G. F. and DEMIDOV, V. P.

[Abstract] Statistics are presented on various aspects of lung cancer in the USSR and compared with the same indices in foreign countries. In the USSR lung cancer has the second largest incidence among cancers and the greatest incidence in males. The incidence of lung cancer in the USSR is increasing at an annual rate of 3.8%, and 3.9% for males. Incidence in the

rural population was still lower than for the urban population in 1978 but was increasingly more rapidly. Relatives figures for incidence in the different USSR republics are shown for the period 1970-1978, and for the entire USSR population broken down by age and sex. Comparative figures are given for Scotland, England, Wales, the Netherlands, Czechoslovakia, Nicaragua, and Thailand. Progressive oncological services in the USSR have resulted in a growing disparity between the incidence of lung cancer and deaths from it and projections indicate that this trend will continue in the future. Figures 2; references 9: 7 Russian, 2 Western.
[220-9642]

UDC: 616-006.04(47+57)"1979"

MALIGNANT NEOPLASMA IN USSR IN 1979 (ANALYSIS OF BASIC INDICES)

Leningrad VOPROSY ONKOLOGII in Russian Vol 27, No 11, Nov 81 pp 3-27

NAPALKOV, N. P., MERABISHVILI, V. M., TSERKOVNYY, G. F. and PREOBRAZHENSKAYA, M. N.

[Abstract] Statistics are presented for the incidence of malignant neoplasms, the second highest cause of death, in the USSR in 1979 according to type of cancer, demography (rural vs. urban populations), geography (political subdivisions, cities in some instances), age and sex, treatment and mortality. Cancer incidence continued to increase in the USSR with the intensity index exceeding 200 per 100,000 for the first time; contrary to the national trend, it decreased in the Kazakh, Moldavian and Latvian SSRs. The national increase is attributed to the greater proportion of the elderly in the general population. Cancer mortality rose by 1.3% and comprised 139.1 per 100,000. The absolute number of cancer deaths reached 366,400; 60 of 100 cancer patients died in 1979 in comparison with 72 in 1970. Cancer incidence was 21.8% higher for urban populations than for rural populations (215.8 vs. 177.1 per 100,000). Cancer incidence among men was also higher than among women: 2.9 and 52.5% higher according to "gross" or standardized indices, respectively. Cancer of the lips tended to increase and had a "gross" index of 5.4/100,000. Esophageal cancer maintained its intensity index of 6.4/100,000 and comprised 3.2% of all cancers. Incidence of gastric cancer decreased with an intensity index of 34.6/100,000. Its percentage among newly diagnosed cancers dropped to 18.6% and mortality dropped by 2.7%. Rectal cancer had a 2.7% higher intensity index with a higher incidence among urban populations and higher gross indices for women. The incidence of laryngeal cancer remained unchanged (3.7/100,000) but mortality increased by 4.1%. Lung cancer had a gross index of 28.7/100,000 with incidence increasing among men. Incidence increased in all republics except the Moldavian SSR. Mortality rose by 3.7%. The incidence of skin cancer increased sharply, particularly in rural populations (by 5.8%). Incidence decreased slightly among men up to 50 years of age but increased substantially in other age groups (by 3.2% for all men). The gross index for women increased by 2.7%. Mortality remained at 1.2/100,000. Breast cancer comprised 7.2% of all cancers and increased in both rural and urban populations (9.3 and 17.5 per 100,000).

Mortality rose by 4.2%. The incidence of cervical cancer tended to decline in rural and urban populations but was recorded more often in cities (11.4 vs. 11.3 per 100,000 for rural populations), which was not previously noted. Incidence remained unchanged for women less than 40 years of age, declined in women 40 to 70 years old, and increased in women over 70. Mortality dropped by 2.1%. Cancer of lymphatic and hematopoietic tissues retained its sixth place (4.4%) among cancers. The intensity index increased by 2.3% with a higher incidence for urban populations. Mortality was 7.6/100,000. Of 358,939 patients receiving specialized treatment, 78,500 has digestive tract tumors, 71,800 genitourinary cancer, 60,900 skin cancer, 45,800 lung cancer, 27,600 tumors in lymphatic and hematopoetic tissues and 36,000 breast cancer. Figures 1; references 12: 7 Russian, 5 Western.
[185-9307]

UDC: 576.895.2:596

PARASITISM OF TERRESTRIAL VERTEBRATES BY ARTHROPODS

Leningrad PARAZITOLOGIYA in Russian Vol 15, No 6, Nov-Dec 81 pp 481-491

BALASHOV, Yu. S., Institute of Zoology, USSR Academy of Sciences, Leningrad

[Abstract] An analysis is made of the relationships between arthropods and vertebrates, which vary from true parasitism through commensalism, a type of symbiosis in which the relationship between the partners is favorable for the arthropod and largely neutral for the host, and mutualism, mutually beneficial and rare in the relationship between arthropod and vertebrate, to micropredation, in which the small arthropod (flea, mosquito) feeds on the host but is capable of living freely apart from the host. It is noted that the term "parasitism" is broadly used to include all of these types of relationships, and that this terminological imprecision, plus the concentration of studies on a few species of arthropods most significant from the economical and health standpoint, has distorted the study of the tremendous variety of relationships between arthropods and vertebrates. Ectoparasitism clearly predominates over endoparasitism in these relationships. Parasitism has developed independently and repeatedly in many taxons during the evolution of ticks and insects. Unfortunately, direct paleontological data are not available to explain the origin and evolution of the most important taxons of parasitic arthropods. References 13: 10 Russian, 3 Western.
[176-6508]

UDC: 59.08:599.32:576.858.27

FORECASTING PLAGUE EPIZOOTIC AMONG ARAL KARAKUM RODENTS

Moscow ZOOLOGICHESKIY ZHURNAL in Russian Vol 61, No 1, Jan 82
(manuscript received 9 Mar 81) pp 122-128

DUBYANSKIY, M. A., DUBYANSKAYA, L. D., ZHUBANAZAROV, I. Zh., KOCHKINA, L. I. and OVCHAROV, A. V., Central Asian Scientific Research Anti-Plague Institute, Alma-Ata

[Abstract] A mathematical model is developed for forecasting the intensity of plague among Rhombomys opimus, the primary carrier of the plague microbe in the Karakum area. The method used involved recording observations in one of two possible classes. The information content of each characteristic observed is recorded, predictors are distributed with an indication of their prognostic coefficient, and the forecast is made by successive statistical analysis, summing the prognostic coefficients with ± signs. In selecting predictors, known information concerning factors influencing plague epizootics were considered. Factors considered included the population of carriers and microbes, their ecological and physiological condition, as well as the influence of weather and other external factors on the rodents. The end result of the forecast concerned the level of infestation of individual points in the territory, reflecting both intensity and extensiveness of the epizootic process. References 8 (Russian).
[181-6508]

UDC: 615.47.03:617-001

TECHNICAL CONSIDERATIONS IN RESOLVING TRAUMATOLOGICAL PROBLEMS

Moscow ORTOPEDIYA, TRAVMATOLOGIYA I PROTEZIROVANIYE in Russian No 3, Mar 82
(manuscript received 2 Feb 81) pp 53-56

SIVASH, K. M. and KOZHIN, N. P., Central Institute of Traumatology and Orthopedics imeni N. N. Priorov, Moscow

[Abstract] Developments and improvements in technical facilities are reviewed with special reference to the paramount importance of providing initial emergency care and transportation for patients with serious injuries of the locomotor apparatus. Medical criteria for the design of ambulance equipment are enumerated and descriptions are given of the design and application of the following ambulance equipment: polyethylene and aluminum splint bars for use in fractures of the arms, legs and feet, the Sivash-Kaz'min splint bar for fractures of the femur, blood and fluid transfusion units, osteosynthesis equipment, and compression and distraction equipment. The importance of initiating rehabilitation therapy as earlier as possible is emphasized. A newly developed improvement of the Balkan frame with additional brackets and rollers permits improved patient access by medical personnel and

allows the patient to start active and passive movements of joints at an earlier stage in treatment. Other equipment facilitating recumbent exercise is described. No references.
[217-9642]

UDC: 616.7-001.08-036.868 (470.23-25)

RESULTS FROM REHABILITATION THERAPY FOR PATIENTS WITH INJURIES OF LOCOMOTOR APPARATUS AT REHABILITATION CENTER OF CITY POLYCLINIC

Moscow ORTOPEDIYA, TRAVMATOLOGIYA I PROTEZIROVANIYE in Russian No 3, Mar 82 (manuscript received 24 Jun 81) pp 48-51

BOGDANOV, Ye. A. and GRIBENNIK, Ye. V., Polyclinic No 51, Leningrad

[Abstract] Results are presented from a 5-year study (1976-80) of 5,966 patients undergoing rehabilitation therapy following injuries to the locomotor apparatus; 401 other patients were not treated because of various unsuitable conditions. Patients were selected for rehabilitation treatment strictly in accordance with guidelines drawn up jointly with the Institute of Traumatology and Orthopedics imeni R. R. Vreden. Some 60.7% of patients were men and 39.3% women; ages varies between 20 and 60. Results from treatment were dependent upon the amount of rehabilitation therapy conducted: the more intensive the process and the greater the number of procedures the better the functional results; some correlation was also found between the number of procedures and the period of work incapacity. Involvement of patients in work of a production nature facilitated and encouraged their ability to overcome pain and attempt locomotor functional activities with greater determination. In addition to work therapy, the main components of rehabilitation included therapeutic gymnastics, mechanical therapy, walking and swimming. Combined therapy employing drugs to stimulate processes of consolidation and function improvement was used extensively. With full anatomic restoration of injured segments, 58.9% of patients recovered full functional use of the locomotor apparatus; partial functional use was reached in 38.4% of patients with anatomic defects; anatomic and functional indexes remained unchanged in 2.5% of cases. According to figures from the No 2 Leningrad Medical Board, 15.8% of patients with shin injuries and 17.6% with spinal injuries are invalided; in the rehabilitation center the corresponding figures for such injuries were 8.5% and 2.4%. Positive results were also achieved in rehabilitation of class II invalids; 29.1% of them were able to return to work. No references.
[217-9642]

UDC: 615.832.9: 616.72-018.3

CHANGES IN ARTICULAR CARTILAGE IN CRYOGENIC TREATMENT

Kiev KLINICHESKAYA KHIRURGIYA in Russian No 1, Jan 82 (manuscript received 9 Jun 81) pp 23-24

SKLYARENKO, Ye. I., PASHKOV, Ye. P. and BRUSKO, A. T., Scientific Research Institute of Orthopedics, Kiev

[Abstract] The effect of low temperature (-196°C) on articular cartilage was studied experimentally using 63 rabbits by performing arthrotomy of the knee joint and freezing part of the articular cartilage in the medial condyle and patellar surface of the femur with a 3-mm cryogenic probe or cryogenic irrigation with liquid nitrogen. Cryogenic action was maintained for periods of 10 secs, 30 secs, and 3 mins. Clinical and X-ray studies were done for periods of 7 to 180 days. Macroscopic and microscopic studies were done on the cartilage, with histological sections stained with hematoxylin-eosin and van Gieson's fuchsin solution. Regardless of the cryogenic method used or the duration of the cryogenic effect, similar changes but of varying intensity were found in the articular cartilage and subcondylar bony tissue. Typically, at 7-21 days the cartilage assumed an off-white coloration while retaining its smooth surface; at days 30-60 the discoloration disappeared and the surface became matted and rough; by day 90 a dish-shaped depression with precisely defined edges appeared and by day 180 this depression had increased in size and the edges were ill-defined, while surrounding articular cartilage acquired a matted appearance. Microscope studies showed necrosis, increasing with time. Restoration of damaged cartilage was not seen during the period of observation. The longer the initial duration of the cryogenic effect the more rapid and extensive the damage. In areas subject to dynamic or static functional loads the dystrophic effect was more rapid than in other non-load-bearing areas. No references.
[218-9642]

UDC: 617-085.2: 615.38

MATHEMATICAL MODELING OF PROCESSES OF EXTRACORPOREAL REMOVAL OF ENDOTOXINS FROM THE BODY

Kiev KLINICHESKAYA KHIRURGIYA in Russian No 1, Jan 80 (manuscript received 4 Jan 81) pp 38-40

BESPALOV, Yu. G. and BERESNEV, A. V., Khar'kov Medical Institute

[Abstract] Present so-called multiple chamber mathematical models used to describe processes of extracorporeal detoxification are inadequate since they do not reflect the body's active response to changes in the concentration of the most important metabolites in the blood. A system of equations is proposed to describe processes of extracorporeal removal of endotoxins

that reflects the dynamics of three interconnected functions, namely those for energy, detoxification and removal, as follows:

$$Q = Q_{max} \frac{K_1 - C_1}{K_1} \quad (1)$$

$$\frac{dC_1}{dt} = Q\left(\gamma - V_1 \cdot C_1 \frac{K_2 - C_2}{K_2}\right) - C_1 V_3 \quad (2)$$

$$\frac{dC_2}{dt} = Q(V_1 \cdot C_1 \frac{K_2 - C_2}{K_2} - C_2 V_2) - C_2 V_3, \quad (3)$$

where Q is the magnitude characterizing the metabolic energy level and Q_{max} its maximum possible value; K_1 is a constant characterizing its dependence on the concentration of the primary metabolite; C_1 is the concentration of primary metabolite in the blood; γ is the coefficient of proportionality linking the rate of entry of the primary metabolite into the blood with the metabolic energy level; C_2 is the blood concentration of the secondary metabolite (the product from detoxification of the primary metabolite); K_2 is a constant characterizing inhibition of detoxification processes by the secondary metabolite; V_1, V_2 and V_3 are the maximum values for clearance from the volume of circulating blood by the natural detoxifying system, the natural removal system and the artificial extracorporeal detoxifying system respectively; and t is time. The system of equations is handled in ALGOL-60 and processed on an M-222 computer. Results are presented from application of the model in a simulation of extracorporeal detoxification in resolved and unresolved obstructive jaundice, where model results matched actual findings.
Figures 1; references 3 (Russian).
[218-9642]

UDC: 616.99-036.25:614:061.14(100)

PROBLEMS IN TROPICAL PARASITOLOGY AND ANALYSIS OF ACTIVITY OF SPECIAL PROGRAM FOR RESEARCH AND TRAINING OF SPECIALISTS IN TROPICAL DISEASES

Moscow MEDITSINAKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI in Russian
Vol 50, No 4, Jul-Aug 81 (manuscript received 25 Feb 81) pp 3-14

SOPRUNOV, F. F., Institute of Medical Parasitology and Tropical Medicine imeni Ye. I. Martsinovskiy, USSR Ministry of Health, Moscow

[Abstract] The work, goals and research groups of the WHO Special Program are evaluated. The goals of the program may be summarized as finding new, and increasing the effectiveness of, available treatments and control measures for the diseases covered by the Special Program and to expand potential research in developing countries to make them active participants in solving their major health problems. The diseases covered in the present article are malaria, schistosomiasis, filariasis, African trypanosomiasis, Chagas disease, leishmaniasis and leprosy. Progress in the area of chemotherapy, immunology, epidemiology, vector control, field studies and research methods

is discussed. Current information on progress in biomedicine is provided by the BIOS program. Demographic, financial, economic and time factors are regarded as major obstacles to solving global problems in tropical diseases. Financial support for research from the United States, Scandinavian countries, Holland and Great Britain, as well as problems in training specialists and administrators from developing countries, are discussed. The Soviet Union's experience in public health in, for example, Vietnam, indicates that successful control of parasitic diseases should be based on a national network with the active participation of affected populations. References 4 (Russian).
[193-9307]

UDC: 616.9-036.25:658.386.3

SPECIAL PROGRAM FOR RESEARCH AND TRAINING OF SPECIALISTS IN TROPICAL DISEASES, CONTRIBUTION 1

Moscow MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI in Russian
Vol 50, No 4, Jul-Aug 81 (manuscript received 24 Jul 80) pp 14-19

NIKOLAYEVSKIY, G. P., VOYSKUNSKAYA, N. I. and SOPRUNOV, F. F., Institute of Medical Parasitology and Tropical Medicine imeni Ye. I. Martsinovskiy, USSR Ministry of Health, Moscow

[Abstract] The organizational structure, functions and financing of the WHO Special Program are analyzed. The Special Program was formed to develop research and train specialists in malaria, schistosomiasis, filariasis, trypanosomiasis, leishmaniasis and leprosy. The specific role and personnel of each research and administrative group are outlined. It is recommended that the USSR participate more actively in this Program, since there are only five Soviet specialists involved in research and management. With respect to financing, contributions to the Program have been made primarily by European countries (67% of total): Finland, Norway and Sweden gave 23.6%, Denmark, Belgium and Holland 31% of the total budget, 56.8% is designated for research and training and 43.2% for administration and equipment. Analysis of grant distribution shows that 309 grants were given to 19 developed countries and 147 grants to developing countries. The majority of grants to industrialized countries went to Great Britain, Belgium, FRG and the United States.
Figure 1; references 2 (Western).
[193-9307]

UDC: 616.936-022.395.771]:001.8:658.386.3

MALARIA VECTORS IN SPECIAL PROGRAM FOR RESEARCH AND TRAINING OF SPECIALISTS IN TROPICAL DISEASES

Moscow MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI in Russian
Vol 50, No 4, Jul-Aug 81 (manuscript received 8 Dec 80) pp 20-23

KASHAYEVA, G. V. and DROBOZINA, V. P., Institute of Medical Parasitology and Tropical Medicine imeni Ye. I. Martsinovskiy, USSR Ministry of Health, Moscow

[Abstract] Basic trends in research on malaria vectors, which is part of the title Special Program, are reviewed. Of 150 malaria research projects, 43 are devoted to field studies primarily in developing countries, and of these, only 14 deal with vectors. The goal of projects with the largest budgets is to develop malaria control measures that could be used in endemic countries with a different incidence and socioeconomic conditions; the largest such project is underway in Nigeria. Another goal is to study the entomological factor in malaria transmission to maintain the malaria-free status of areas adjacent to infected areas. The value of studying the bionomics and ecology, significance as vectors, behavior and behavioral genetics of mosquitoes is also discussed. Development and distribution of insecticide resistance in malaria vectors and the search for and testing of new chemical control agents (e.g., larvicides) are described. Considerable attention and financial support have also been focused on vector biological control, which includes use of bacteria, fungi, fish, nematodes and mosquito predators. The area of biological control also includes the search for new agents, laboratory and field studies, studies on environmental safety and toxicity for humans and animals, as well as taxonomic studies.
[193-9307]

UDC: 614.449.57:576.895.711+615.285.7.36.8](851)

EXPERIENCE IN USING MALATHION FOR ANOPHELES CONTROL IN IRRIGATED AREAS IN NORTHEASTERN AFGHANISTAN

Moscow MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI in Russian
Vol 50, No 4, Jul-Aug 81 (manuscript received 7 Mar 80) pp 36-43

ANUFRIYEVA, V. N., POLEVOY, N. I., KHAYRETDINOV, D. G. and ARSEN'YEVA, L. P., Institute of Medical Parasitology and Tropical Medicine imeni Ye. I. Martsinovskiy, USSR Ministry of Health, Moscow

[Abstract] The effect of malathion treatment on malaria incidence and mosquito populations was studied in 1978 in 178 villages in a rice-growing region of Afghanistan. The primary malaria vectors were Anopheles pulcherrimus and A. hyrcanus. The effectiveness of spraying houses with malathion (50% wettable powder, 2 g/m^2) in late June was tested in two villages: Tarnob (treated and Kirgiz (untreated). A. pulcherrimus was highly sensitive to

malathion with 100% mortality of females after a 15-min exposure. The A. pulcherrimus populations in the treated village consisted primarily of young females (90-94.3%) with a few egg-laying females; the number of potentially infectious females in the untreated village reached 5.4-13.2% (June-August). Malathion had a less marked effect on A. hyrcanus. The number of malaria patients in the untreated village increased 90% in comparison with 1977 and decreased nine-fold in the treated village. Similar drops in incidence were also obtained in other areas. One region, however, produced minimal results despite two treatments because of the large number of temporary dwellings. The first malathion treatment was effective against A. pulcherrimus for 10 weeks; a second treatment at that time is recommended. Figures 3; references 31: 5 Russian, 26 Western.
[193-9307]

UDC: 576.858.25.095.38:595.42-134.2

CHARACTERISTICS OF REPRODUCTION OF RUSSIAN SPRING-SUMMER ENCEPHALITIS AND POWASSAN VIRUSES IN NYMPHAL CUTICLE EXPLANTS OF DERMACENTOR SILVARUM IMAGOES

Moscow MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI in Russian
Vol 50, No 4, Jul-Aug 81 (manuscript received 9 Sep 80) pp 61-64

CHUNIKHIN, S. P., KOCHETOVA, G. A., STEFUTKINA, L. F. and KOROLEV, M. B., Poliomyelitis and Viral Encephalitides Institute, USSR Academy of Medical Sciences, Moscow

[Abstract] The virological and electron microscopic study of the reproduction of the Russian spring-summer encephalitis (RSSE) (strain B-493 from Ixodes persulcatus) and Powassan (strain P-40 from Haemaphysalis longicornis) viruses was performed in explants of Dermacentor silvarum imagoes, which were used for the first time as an in vitro system for vital reproduction. Infectious doses for the RSSE virus were 3 and 4 log LD_{50} and for the Powassan virus, 2 and 3 log LD_{50}. Albino mice were used for titration assays. The dynamics of virus accumulation were similar for both viruses. Viral reproduction was observed up to 62 days following infection. Use of Dermacentor explants was preferable to salivary gland cultures in that the explants retained their histotypic features; this made it possible to determine the differential sensitivity of various cell types to the viruses and to study viral morphogenesis in tissues and organs of the virus vector. A total of 50-60% of incomplete viral forms reproduced in explant cells versus 8-10% in salivary gland cells. The lower infectious doses were optimal for explants. Explants may also be used to study transphasic and transovarial transmission of the arboviruses. Figure 1; references 6: 1 Russian, 5 Western.
[193-9307]

UDC: 615.283.926(088.8)

SEARCH FOR NEW ANTIMALARIA COMPOUNDS (REVIEW OF PATENTS)

Moscow MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI in Russian
Vol 50, No 4, Jul-Aug 81 (manuscript received 29 Nov 80) pp 80-86

DRABKINA, A. A., BAYBIKOVA, T. A., NIKOLAYEVSKIY, G. P. and SOPRUNOV, F. F.,
Institute of Medical Parasitology and Tropical Medicine imeni
Ye. I. Martsinovskiy, USSR Ministry of Health, Moscow

[Abstract] Patents for antimalaria preparations developed in the last 5-10 years, primarily in Western Europe and the United States, are reviewed. The search for new drugs has been necessitated by the extensive distribution of chloroquine-resistant malaria strains. Of more than 1000 patented compounds, few pass clinical trials and even fewer are finally used. Research is described and patent holders and dosages are given for 4-aminoquinolines and analogs, 6-aminoquinilines, 4-hydroxyquinolines, quinoline methanols, benzo[g]quinolines (developed in the USSR), aminopyrimidines and pteridines, quinazolines, triazines, pyridine methanols, 1,4-disubstituted piperazines, tetrahydroacridones, sulfones, sulfanilamides and other sulfur-containing derivatives and phenol derivatives. Combination preparations have become increasingly important. Those discussed include dapsone and amodiaquin, dapsone and primaquine, and pyridine and 4-hydroxyquinidine. References 67: 12 Russian, 55 Western.
[193-9307]

UDC: 577.3

CONCEPTUAL MODEL OF FUNCTIONAL ORGANIZATION OF THE BRAIN (QUANTUM-BIOLOGICAL APPROACH)

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 1, Mar 82 (manuscript received 21 Sep 81) pp 205-207

MUSKHELISHVILI, N. L. and SERGEYEV, V. M., Institute of Molecular Genetics, USSR Academy of Sciences, Moscow

[Abstract] The brain can be considered a hierarchically-organized integral system in which the neurophysiological and quantum levels of organization, the intermolecular and intramolecular interactions, are organically related. The quantum level can have macroscopic manifestations. The following model of brain function is used: the possible states of each cell are described by a certain set of wave functions. The equations for these functions are presented as a Hartry-Fock system which should have self-consistent solutions. If the status of the system is determined by both internal and external parameters such as sensory inputs, as the inputs change the status of the system as a whole changes, involving transition from one self-consistent state to another. In spite of the simplicity of the model, it yields some nontrivial conclusions: 1) the model is basically a two-level model; 2) the model describes an analog device requiring no time for transition from one state to the next; 3) the model allows restructuring, with changing states corresponding to its change in the classic description of the brain. The model allows parallels to be drawn between the structure of the brain and the structure of the psyche. References 10: 4 Russian, 6 Western.
[155-6508]

UDC: 591.524.2: 599.323

COMPARATIVE CHARACTERISTICS OF BIOCHEMICAL INDICES IN ADAPTATION AND NATURAL RESISTANCE TO MOUNTAINOUS CONDITIONS IN RODENTS

Leningrad ZHURNAL EVOLYUTSIONNOY BIOKHIMII I FIZIOLOGII in Russian Vol 18, No 1, Jan-Feb 82 (manuscript received 14 Nov 79) pp 97-100

KOMOLOVA, G. S., MAKEYEVA, V. F., YEGOROV, I. A. and ZAKIROV, D. Z., Institute of Biochemistry imeni A. I. Bakh, USSR Academy of Sciences, Moscow

[Abstract] A comparative study was made of DNA, RNA, protein metabolism and cAMP and cGMP contents in spleen lymphocytes from rats and high-altitude marmot species in adaptation to high-altitude conditions, using mainly radioisotope methods. In rats, DNA and RNA synthesis declined almost 50% during early adaptation but normalized by day 35; no reliable differences were found in the nucleic acid content; protein synthesis also declined and remained low through the period of observation (35 days). These same indices remained higher in marmot species (Citellus fulvus and C. relictus) whose natural habitat is high mountainous. cAMP content was higher than in controls after 30 days (21%); cGMP declined initially and then returned to normal levels. Findings indicate an important role for homeostatic mechanisms during the process of adaptation, and also that, given the identical final results to adaptation in the different species and the more rapid adaptation of high-altitude species, genetic factors may play a role in reinforcing the activity of homeostatic systems. Figures 1; references 10: 4 Russian, 6 Western. [219-9642]

UDC: 612.821.6

DIFFERENCES OF BEHAVIORAL ACTS INDUCED NATURALLY BY ELECTRICAL STIMULATION OF BRAIN

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian Vol 32, No 1, Jan-Feb 82 (manuscript received 8 Dec 80) pp 20-24

BELENKOV, N. Yu., SHALKOVSKAYA, L. N. and GONZALES, B. L., Chair of Normal Physiology, First Leningrad Medical Institute imeni I. P. Pavlov; (Gonzales is attached to the Medical Faculty of the University of Santiago de Cuba)

[Abstract] The reinforcing properties of a purposeful attack provoked by stimulation of the hypothalamus and the properties of natural behavior based on a certain motivation and exteroceptive stimuli was compared in two cats. Reinforcement of the conditioned signal by behavior effects of a purposeful attack induced by electrical stimulation of the hypothalamus is not accompanied by formation of a conditioned reflex in stimulated cats. The reactions of the purposeful attack induced by central stimulation can be changed to a reaction of passive defense or feeding due to the effect of the corresponding conditioned signals and natural motivation. The impossibility

of conditioned reflex reproduction of a purposeful attack induced by stimulation of the hypothalamus is caused by the absence of natural motivation in animals hence the behavior acts induced by stimulation of the brain are not retained in the memory. Figures 1; references 12: 7 Russian, 5 Western.
[123-6521]

UDC: 612.821.6 + 612.821.2

INTERHEMISPHERIC FUNCTIONAL RELATIONS IN PREPARING 'MOTOR COMMANDS' FOR CHOICE REACTIONS

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian Vol 31, No 6, Nov-Dec 81 (manuscript received 27 Jan 81) pp 1123-1130

KOSTANDOV, E. A., ZAKHAROVA, N. N. and POGREBINSKIY, S. A. All-Union Scientific Research Institute for General and Forensic Psychiatry imeni V. P. Serbskiy, Moscow

[Abstract] Eleven healthy staff personnel of the institute, in a semi-reclining position in a darkened chamber, were given warning and action stimuli with intervals of 80-800 ms to trigger pressing a button with left or right index finger. Presentations of stimuli were varied in length and in left or right field of vision. Analysis of the data received indicated that in an interval range of 150-500 ms, reaction time was significantly shorter when the warning and triggering stimuli were presented to the brain hemisphere that was to produce the motor response. A 200 ms pause was the point at which reaction time began to shorten significantly. The spatial location of the warning signal did not affect reaction time. Figures 2; references 12: 5 Russian, 7 English.
[135-12131]

UDC: 612.821.6 + 612.85

RECOGNIZING SOUND SIGNAL FEATURES THAT SIMULATE MOVEMENT OF SOUND SOURCE

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian Vol 31, No 6, Nov-Dec 81 (manuscript received 1 Sep 80) pp 1157-1163

KALMYKOVA, I. V., Laboratory of Hearing Physiology, Institute of Physiology imeni I. P. Pavlov, USSR Academy of Sciences, Leningrad

[Abstract] Six dogs were first trained to lift their left paw when a sound source was moved left to right, and vice-versa. Then they were trained to lift the left paw upon a moving signal and the right upon a stationary sound. Electric shocks were administered for wrong responses. In the testing stage (without shocks), the dogs' ability to determine direction of motion was

recorded in 4 series, involving sounds of differing intensities and lengths. Results showed that for both motion/stationary and directional perception, values of 80-15 Hz, 4.5 decibles and 130 microseconds were required. A third series of tests sought to determine the minimum length of a series of clicks needed to recognize motion and direction of sound. At least 130-180 microseconds were required. In a fourth series, a sound frequency of 1.5-2.5 khz was established for successful performance. The overall results indicated that dogs use criteria similar to those used by humans in discerning these sound motion phenomena. Figures 5; references 7: 3 Russian, 4 English. [135-12131]

UDC: 612.821.6

ROLE OF SPECIES-SPECIFIC ACOUSTICAL SIGNALS IN HOMING ORIENTATION OF INTACT AND ANOSMIC KITTENS

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian Vol 31, No 6, Nov-Dec 81 (manuscript received 22 Jan 81) pp 1171-1178

LUSHCHEKIN, V. S., Laboratory of Brain Function Ontogenesis, Institute of Higher Nervous System Functions and Neurophysiology, USSR Academy of Sciences, Moscow

[Abstract] To measure kittens' ability to find the nest at early ages, a simple maze was constructed with temperature balance and olfactory clearning so as to isolate sound stimuli as the sole homing signal. Purring noises of the mother during nursing and "calling" meows were used to attract intact kittens and those deprived of smell sensations (by administering a zinc compound). At 3-5 days, intact kittens rarely found the nest, but by 9 days 40% had the homing orientation and at 18 days, 86% could find their way. With increasing age, interest in finding the nest decreased as did anxiety at being removed. Eliminating the olfactory sense retarded homing, so that at 18 days only 60% found their way; i.e., once vision became effective the sense of smell lost its importance. Purring sounds were less disturbing than meows, which caused the kittens to seek the source of sound even after finding the nest. This effect was statistically confirmed only at 20-22 days. The calling sounds continued to effectively promote homing until the kittens were a month old, while purring sounds lost effectiveness earlier. Homing orientation was shown to be possible in the absence of olfactory and temperature stimuli. By a month of age, exploring began to supplant homing orientation. Figures 5; references 21: 4 Russian, 17 Western. [135-12131]

UDC: 612.821.6 + 612.8.015

LEARNING OF RATS WITH VARYING EMOTIONAL REACTIVITY AND ITS RELATION TO BRAIN MONOMINES

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian
Vol 31, No 6, Nov-Dec 81 (manuscript received 31 Dec 80) pp 1238-1246

GROMOVA, Ye. A., KATKOV, Yu. A., KALMYKOV, V. L. and BOBKOVA, N. V.,
Institute of Biological Physics, USSR Academy of Sciences, Pushchino

[Abstract] Initial screening identified Wistar rats who developed nervous reactions to a sound irritant of 90 decibles for 1.5 minutes. A control group of emotionally stable rats was also identified. Then both groups were conditioned to respond to electrical shock pain, administered through the floor of a chamber, which they could avoid by reacting to a light flash. Study of the learning dynamics of the two groups indicated that the emotionally unstable group learned to avoid the shocks more quickly. After the tests, the brains of all animals were analyzed for noradrenaline, dopamine, serotonin and 5-hydroxyindollacetic acid. The emotionally unstable rats showed greater shifts in monoamines and catecholamines than in noradrenaline. Increased dopamine in the brain stem suggests insufficient enzyme activity of dopamine-beta-hydroxylases in the unstable group, while relatively higher noradrenaline than serotonin content indicates the primary role of the noradrenergic system in avoidance reactions. Figures 4; references 20: 14 Russian, 6 English.
[135-12131]

UDC: 591.185.6

RECEPTOR SIGNAL TRANSMISSION IN PHOTORECEPTORS

Leningrad ZHURNAL EVOLYUTSIONNOY BIOKHIMII I FIZIOLOGII in Russian
Vol 17, No 5, Sep-Oct 81 (manuscript received 28 May 81) pp 498-501

GRIBAKIN, F. G., Laboratory of Evolutionary Morphology, Institute of Evolutionary Physiology and Biochemistry imeni I. M. Sechenov, USSR Academy of Sciences, Leningrad

[Abstract] A discussion is presented of the unique capacity of photoreceptors to respond to constant illumination with a constant receptor potential, resulting in transmission electrotonically of the incoming signal to higher levels in the CNS. It appears that a single photon triggers a change in the ohmic resistance of the photoreceptor plasma membrane; this alteration in the resting potential constitutes a single constant current impulse and obviates the need for a special mechanism designed for spike generation. This mechanism appears operable in all photoreceptors regardless of their phylogenetic or morphologic category. References 31: 14 Western, 17 Russian.
[152-12172]

UDC: 613.2+614.712]:614.73

CONTENT OF ARTIFICIAL RADIONUCLIDES IN ATMOSPHERIC AIR AND SOME FOOD PRODUCTS IN MOSCOW DURING 1977-1979

Moscow GIGIYENA I SANITARIYA in Russian No 11, Nov 81 (manuscript received 8 Dec 80) pp 60-61

ZYKOVA, A. S., TELUSHKINA, Ye. L., YEFREMOVA, G. P., KUZNETSOVA, G. A. and KISELEV, V. V.

[Abstract] Continuous observations of the content of radioactive materials in precipitation, atmospheric air and in some vegetable and animal food products were made in Moscow and Moscow Oblast during 1977-1979. The density of radioactive precipitation for each month of the indicated period was determined in Moscow and the suburban zone by continuous collection of radioactive precipitation at 10 stations located in the city and the suburban zone. The density of fallout of radioactive precipitation during the year was different for different periods and the maximum amount of radioactive substances occurred during the spring-summer and fall seasons. The density of radioactive fallout in 1977 was $19.4 \cdot 10^8$ Bk/km^2 and exceeded the 1976 indicators twofold. The density of radioactive fallout decreased by one half in 1978 compared to 1977 and was only $5.8 \cdot 10^8$ Bk/km^2 in 1979. There was a tendency for a decrease of Sr-90 and Cs-137 in all samples of food products during the period 1977-1979 except for peas in which the concentration of these radionuclides was higher in 1978 and 1979 than in 1977. The amount of radioactive fallout and radionuclide concentrations in the atmosphere doubled in 1977 compared to 1976 and this level decreased by a factor of 3-5 during 1978 and 1979. References 1 (Russian).
[110-6521]

UDC: 577.391:599:32:532.125.5

ROLE OF GLUCOCORTICOIDS AND INSULIN IN ALTERING ENERGY METABOLISM IN SPLEENS OF IRRADIATED RATS

Kiev UKRAINSKIY BIOKHIMICHESKIY ZHURNAL in Russian Vol 54, No 2, Mar-Apr 82 (manuscript received 15 Dec 80) pp 171-175

SUTKOVOY, D. A., Kiev Scientific Research Institute of Roentgenology and Radiology and Oncology, UkSSR Ministry of Health

[Abstract] The functions of hydrocortisone and its physiological antagonist insulin were studied in post-radiation changes of oxidizing phosphorylation and adenylic nucleotide levels in rat spleens. Rats were thoroughly irradiated twice, with a 7-day interval, then 72 hours later decapitated. Hydrocortisone and insulin were injected in body-weight-determined amounts beginning 24 hours after irradiation and ending at the time of decapitation. Both 11-hydroxycorticosteroids (by 66%) and insulin (by 47%) increased in blood plasma 72 hours after irradiation, with the former predominant. Insulin injection brought an increase in insulin by a factor of 7, while 11-hydroxycorticosteroids remained constant. Double irradiation suppressed oxygen absorption by the mytochondria, with significant retardation of phosphorylation. Insulin stimulated these processes in irradiated rats. Levels of ADP and ADP phosphorylation were also reduced. Insulin eliminated the effects of hydrocortisone on energy metabolism both without and after radiation treatment. References 21: 19 Russian, 1 English, 1 German. [141-12131]

UDC: 616-001.28-02:539.125.5

EFFECT OF NEUTRONS OF FISSION SPECTRUM ON HUMAN BODY AND FEATURES OF NEUTRON INJURY

Moscow VOYENNO-MEDITSINSKIY ZHURNAL in Russian No 10, Oct 81 pp 34-37

GEMBITSKIY, Ye. V., professor, lieutenant general of medical service, VLADIMIROV, V. G., doctor of medicine, major general of medical service, and POPOV, A. V., professor, colonel of medical service

[Abstract] Radiation tests with animals, human simulations, results of radiotherapy and general principles were studied to assess the biological effects of neutron radiation for purposes of triage, diagnosis and treatment. Neutron radiation affects hydrogen, carbon, oxygen and nitrogen atoms in the body, causing massive biological damage that far surpasses the effects of gamma- and X-ray-radiation. DNA damage caused by neutron radiation is irreversible, and brings genetic defects. The tissues and organs of the body closest to the radiation source suffer much greater damage than those

partially shielded by other body parts. In larger bodies, secondary gamma-radiation begins to play a more significant role than otherwise. The development of mixed and transitional forms of radiation sickness complicates diagnosis and prognosis for affected individuals.
[143-12131]

UDC: 577.391.612:015.33

EFFECT OF cAMP ACCUMULATION ACTIVATORS ON INDIVIDUAL STAGES OF GENOME EXPRESSION IN CELLS IN ACUTE RADIATION DAMAGE, REPORT 1: EFFECT OF SEROTONIN AND PAPAVERINE ON RNA BIOSYNTHESIS AND EXPRESSION FROM NUCLEI OF LIVER AND SPLEEN CELLS IN RATS IN EARLY PERIOD FOLLOWING TOTAL-BODY X-RAY IRRADIATION

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 4, Jul-Aug 81 (manuscript received 2 Jun 80) pp 495-501

TSUDZEVICH, B. A., GALKINA, L. A. and KUCHERENKO, N. Ye., Biology Faculty, Kiev State University imeni T. G. Shevchenko

[Abstract] Arguments supporting a correlation between increased cellular cyclic AMP concentration and enhanced resistance to radiation effects were further investigated in a series of studies done on the effect of the adenylate cyclase activator serotonin and the phosphodiesterase inhibitor papaverine on individual stages in the expression of genetic information in the early postradiation period. Experiments were conducted on male mongrel rats irradiated with a total body dose of 7.76 Gr (800 rad) with administration of 20 mg/kg papaverine and serotonin abdominally 15 minutes before irradiation. RNA synthesis and expression was studied in liver and spleen sections. Findings showed that both papaverine and serotonin lead to stabilization of RND synthesis in both the organs studied, thus providing some degree of radioprotection. It is suggested that early stabilization of RNA biosynthesis takes place at the stage of transcription, extending at later stages to RNA processing and expression. Further studies to determine the chromatin matrix activity and the processes of initiation, elongation and termination of transcription and the rate of processing will be required to confirm this view. Figures 2; references 12: 8 Russian, 4 Western.
[183-9642]

UDC: 577.391:612.42

LYMPH NODE RESPONSE IN MICE TO ADMINISTRATION OF VACCINE FOLLOWING NONUNIFORM IRRADIATION

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 4, Jul-Aug 81 (manuscript received 5 May 80) pp 537-543

POZHARISSKAYA, T. D., ALEKSEYEVA, I. I., SVIRIDOV, L. P. and SOKOLOVA, Ye. N.

[Abstract] Studies were conducted to investigate restoration of lymphoid tissue and proliferation of cellular elements in vaccination following uniform

and nonuniform (rear half of body screened) irradiation. Experiments were conducted on line CC57W mice irradiated with a dose of 6 Gr; animals were vaccinated with a 0.1 milliliter dose of the typhoid vaccine "sekstanatoksin" up to 30 days before and at 5 hours after irradiation. Organs of the lymphatic system were studied (determination of pre- and postradiation relationships between small and medium lymphcoytes, blasts and reticular and plasma cells and histoautoradiography of 3H-thymidine-labeled lymph node cells to assess proliferation) before irradiation and at 1, 3, 5 and 14 days after irradiation. Findings showed a marked increase in the weight of lymph nodes at days 5 and 14 after irradiation: in uniform total-body irradiation, some decrease in the weight of the lymph nodes was noted at postradiation day 3; in nonuniform irradiation lymph node weight increased steadily through day 14. Nonuniform irradiation led to rapid restoration in irradiated lymph nodes, as seen from the large number of lymphatic cells in the outer cortex of lymph nodes. When vaccination was done after irradiation the number of plasma cells in the splenic pulp increased sharply after 1 day. It is concluded that vaccination can be regarded as factor promoting regeneration in irradiated cells. Figures 3; references 6: 4 Russian, 2 Western.
[183-9642]

UDC: 577.391:612.015.33:612.111

RED CELL PROTEIN METABOLIC INDICES IN RADIATION SICKNESS AND ADMINISTRATION OF CYSTAMINE

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 4, Jul-Aug 81 (manuscript received 29 Jun 80) pp 577-581

SEREBRENNIKOVA, I. A. and KOLESOVA, N. I., Tomsk Medical Institute

[Abstract] Following earlier studies in which it was established that radiation sickness caused impairment of the protein-lipid complex in the red cell stroma, a more detailed investigation was made of protein metabolism in high-energy irradiation, and the effect of cystamine on metabolism. Experiments were conducted on rabbits irradiated with a does of 10 Gr using a 25 MeV betatron. Blood analysis (total and residual nitrogen, nitrogen urea, amine nitrogen and free amino acids, activity of proteolytic enzymes) was done before irradiation and 1, 4, 10, 20 and 30 days after irradiation, with and without administration of cystamine (100 mg/kg intravenously). In irradiation of animals without cystamine 30-day survival was 67%; in irradiation with cystamine 30-day survival increased to 82 percent. Since administration of cystamine did not affect the indices studied it is suggested that the protective effect of cystamine is realized through some other cellular mechanism(s), possibly by reacting with radicals to maintain membrane integrity in the formation of free radicals. References 17 (Russian).
[183-9642]

UDC: 577.391:621.039.58:663.12/14

ROLE OF ENDOGENOUS SUBSTANCES IN CREATING BACKGROUND FOR RADIORESISTANCE, REPORT 15: SEROTONIN PARTICIPATION IN FORMATION OF RADIORESISTANCE UNDER PHOTOPROTECTIVE CONDITIONS IN PICHIA QUILLIERMONDII YEAST CELLS

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 4, Jul-Aug 81 (manuscript received 1 Jul 80) pp 588-590

GONCHARENKO, Ye. N., ANTONOVA, S. V., GORSKAYA, T. G., KAPLYA, S. A. and MINEYEVA, M. F., Biology Faculty, Moscow State University imeni M. V. Lomonosov

[Abstract] Experiments were conducted to determine the role of serotonin acting as an endogenous amine in enhancing radioprotection after preliminary irradiation of Pichia quilliermondii cells with UV-light at 365 nanometers, in which higher levels of biogenous amines, particularly serotonin, have been found. It is known that parachlorophenyl alanine (p-CPA) inhibits tryptophan hydroxylation, a crucial step in serotonin synthesis. Accordingly, the effect of p-CPA was determined as related to the degree of radioprotection under various conditions of UV-irradiation. Findings showed that the radioprotection effect is cause-related to the accumulation of serotonin in the yeast cells and that the increase in the serotonin level results from the action of long-wave UV-irradiation on the limiting stage in serotonin synthesis, namely tryptophan hydroxylation. Figures 1; references 4: 3 Russian, 1 Western.
[183-9642]

UDC: 577.391:621.039.58

RADIOPROTECTIVE PROPERTIES OF SHIGELLA ANTIGENS

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 4, Jul-Aug 81 (manuscript received 16 Aug 79) pp 591-594

GORBUNOVA, Ye. S., MAL'TSEV, V. N. and TYURIN, Ye. A.

[Abstract] The possibility of using polyvalent preparations of Shigella flexneri and Sh. sonnei antigens as radioprotective agents against gamma-radiation was investigated. Vaccines were obtained using a new, sparing method. Experiments were conducted on 2,000 mice; the agents were administered (subcutaneous and enteral) before and after total-body 60-C gamma-irradiation (dose 800-900 rads at 115.6 rads/min). Experimental results showed that survival rate in animals receiving the agents was up to 55% higher than in controls. Optimal doses of the agents were established at 0.5 milligrams in subcutaneous administration and 3 milligrams by the enteral route when used 7 days before irradiation; best postradiation effects were obtained when the dose was given at 4 hours after irradiation; administration orally at 24 hours after irradiation was ineffective. The agents also gave enhanced protection against infection with the Shigella bacteria. It is concluded that there are grounds for further studying these agents both as radioprotective agents and as dysentery vaccines. Figures 1; references 8: 7 Russian, 1 Western.
[183-9642]

UDC: 577.391:621.039.58

THERAPEUTIC USE OF HETEROLOGOUS SERUM GLOBULIN IN ACUTE RADIATION SICKNESS IN MICE

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 4, Jul-Aug 81 (manuscript received 30 Mar 80) pp 595-597

DOBRONRAVOVA, N. N., KUZ'MINA, T. D., ULANOVA, A. M., NEVINNAYA, A. P., SHAL'NOVA, G. A. and GOL'TSEV, I. A.

[Abstract] A comparative study was conducted on the therapeutic effectiveness of heterologous preparations of serum globulin using various routes of administration. Experiments were conducted on 2,705 mice weighing 18-22 grams, irradiated with 60-C gamma rays (800-900 rads at 120-95 rads/min). Canine-derived globulin containing the alpha, beta and gamma fractions, with normal and enhanced autoantibody contents, was administered subcutaneously three times to experimental animals at 2, 24 and 48 hours after irradiation for a total dose of 100 mg/kg. No other therapeutic or prophylactic agents were used. The period of observation was 30 days following irradiation, with determination of body weight and deaths and mean survival time. Findings showed that mice treated with immunoglobulin from dogs with enhanced serum globulin autoantibody content had a survival rate 40% better than controls. References 7 (Russian).
[183-9642]

UDC: 577.391:612.039.58

MODIFICATION OF RADIATION DAMAGE BY COENZYME Q9

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 4, Jul-Aug 81 (manuscript received 19 Sep 80) pp 609-611

ZASLAVSKIY, Yu. A., SHISHKINA, L. N., KOZHOKARU, A. F., ALEKSEYEVA, L. V. and AKOYEV, I. G., Institute of Biological Physics, USSR Academy of Sciences, Pushchino

[Abstract] Studies were conducted to clarify the possibility of using coenzyme Q9 administered at various periods before irradiation to modify the effect of the radiation. Experiments were conducted on male mongrel mice weighing 20-22 grams irradiated with a dose of 7.5 Gr using a 60-C source. The Q9 coenzyme was administered peritoneally (80 mg/kg) 0.5, 2, 4, 6, 8, 10 and 12 hours before irradiation. It was found that coenzyme Q9 administered in the dose indicated 4 to 12 hours before irradiation exerted a marked radioprotective effect; survivability increased 35-40% compared with controls and survival time was virtually doubled. When the coenzyme was administered 0.5 to 2 hours before irradiation the protective effect was only very slight. It is suggested that the enhanced protection against radiation effects offered

when the coenzyme is administered at the longer periods before irradiation is associated with greater lipid antioxidant activity induced by the coenzyme Q9; evidently it takes longer for the antioxidant system to be restructured after administration of coenzyme Q9 than it does when other radioprotection agents are used. References 6: 5 Russian, 1 Western.
[183-9642]

UDC: 577.391:591.484

MICRODISTRIBUTION OF 239-Pu IN CANINE EYE AFTER INHALATION IN DIOXIDE FORM

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 4, Jul-Aug 81 (manuscript received 11 Aug 80) pp 620-622

LEVDIK, T. I., MIKHAYLINA, T. N. and BULDAKOV, L. A.

[Abstract] A study was made of localization of 239-Pu in the lens and tunica conjunctiva after inhalation of the dioxide of plutonium-239. Experiments were conducted on mongrel dogs aged 2-3 years. Histoautoradiographs showed that as soon as the plutonium entered the blood from the lungs it was concentrated preferentially in the pigment layer of the retina. After 1.5 to 5 months the greatest concentration of the radionuclide was seen in cellular elements of the retina and extracellular pigment nodules; only isolated alpha-tracks were seen in other retinal layers at this time; plutonium was found in all the vascular lumina and accumulated in the vascular tunicae. It is concluded that visual impairments, including the development of cataracts, are directly associated with the action of the alpha radiation. Figures 1; references 6 (Russian).
[183-9642]

UDC: 577.391:661.879

EFFECT OF INTRATRACHEAL ADMINISTRATION OF PLUTONIUM-239 ON SEXUAL FUNCTION IN FEMALE RATS AND PROGENY

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 4, Jul-Aug 81 (manuscript received 4 Feb 80) pp 623-626

OVCHARENKO, Ye. P. and ROZHKOVA, R. P.

[Abstract] Most studies of the effect of radioactive substances on the sexual organs, fetus and progeny have been done with intravenous administration of the radioactive substance. The present study was done to fill an apparent lacuna in information on these effects in intratracheal administration of the radioactive substance. Experiments were conducted on 276 female Wistar rats with an initial body weight of 150-160 grams. The nitrate of plutonium-239

(pH 6.5) was administered into the trachea in a volume of 0.2 milliliters for 37, 74 and 185 kBq/kg. Effects of the radioactive substance were judged from the estrous cycle, copulation, deaths of litter and partial embryo deaths on day 14 of pregnancy. Total lung doses ranged between 1.21 Gr and 63.86 Gr after administration of the doses indicated; total absorbed dose in the ovaries was much lower, varying between 0.02 grays and 1.72 Gr. Increased mortality was noted in experimental animals: 180-day survival after administration of 37, 74 and 185 kBq/kg plutonium-239 was 86.6, 93.3 and 46.6 percent compared with controls. No marked changes were found in the estrous cycle, copulation, litter deaths or embryo deaths. Statistically reliable differences found in the peripheral blood (higher thrombocyte count, lowered hemoglobin) did not appear to have any pathophysiological significance. No radioactivity was found in the progeny; lymphopenia could be induced in progeny by acute gamma irradiation. References 8 (Russian).
[183-9642]

UDC: 577.391:539.125.5

ABSENCE OF ADDITIVE EFFECT IN COMBINED IRRADIATION OF SEEDS AND SEEDLINGS OF CREPIS CAPILLARIS WITH GAMMA-RAYS AND NEUTRONS

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 4, Jul-Aug 81 (manuscript received 5 Aug 80) pp 630-632

FESENKO, E. V. and LUCHNIK, N. V., Scientific Research Institute of Medical Radiology, USSR Academy of Medical Sciences, Obninsk

[Abstract] Lethal effects and chromosome aberrations were studied in seeds and seedlings of Crepis capillaris in separate and combined irradiation by gamma-rays and neutrons, with particular reference to the role played by the gamma-rays, which are usually disregarded in the effect of neutron streams when determining dose levels for radiation therapy. A dose of 4 Gr of fast neutrons at an energy of 0.85 MeV (1.8 GR/min) and 50 Gr gamma irradiation was delivered in various combinations and sequences to dormant seeds with a 15% water content; seeds were grown immediately after irradiation. The findings were as follows: in combined irradiation of seedlings, total numbers of chromosome aberrations were lower than anticipated from the effect of two kinds of radiation, and lower than the effect resulting from the use of neutrons alone; the same combination in dormant seeds induced more chromosome aberrations than expected from a simple additive effect. Thus, it appears that the gamma component exerts a modifying effect in neutron irradiation of the seedlings. All experimental versions were done simultaneously and results were reproducible, indicating that the physiological status of the cells was an important factor. Findings are discussed with reference to radiation effects on DNA metabolism. References 11: 2 Russian, 9 Western.
[183-9642]

UDC: 577.391:621.039.58

RADIOPROTECTIVE ACTIVITY AND IN VITRO MECHANISMS OF ACTION OF BIOGENIC AMINES ON MAMMALIAN CELL CULTURES

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 5, Sep-Oct 81 (manuscript received 28 May 80) pp 683-687

GRAYEVSKIY, E. Ya. (deceased), YANUSHEVSKAYA, M. I., BUYEVEROVA, E. I., BRAGINA, Ye. V. and KONSTANTINOVA, M. M., Institute of Developmental Biology imeni N. K. Kol'tsov, USSR Academy of Sciences, Moscow

[Abstract] Chinese hamster fibroblast cultures were employed in studies on the radioprotective effects of epinephrine (EN) and serotonin (5-HT) for comparison with the established radioprotective agent cysteamine (CA) used in nontoxic concentrations. The results demonstrated that 5-HT addition, either before or after irradiation (300 rads), led to a significant increase in cell survival; EP was effective only when added before irradiation. Similar effects were seen in terms of reducing the number of cells with chromosomal abnormalities. Addition of CA prior to irradiation significantly increased cell survival, while its addition after irradiation depressed cell survival to below control levels. In addition, CA was effective in decreasing the incidence of chromosomal aberrations only if applied before irradiation. The data were interpreted to indicate that 5-HT effects do not represent a 'genuine' radioprotective phenomenon, but rather attenuation of radiation-induced damage. References 20: 8 Western, 12 Russian.
[147-12172]

UDC: 612.017.2"5"

MECHANISMS OF ADAPTATION IN BIORHYTHMOLOGICAL ASPECTS

Moscow VESTNIK AKADEMII MEDITSINSKIKH NAUK SSSR in Russian No 12, Dec 81 (manuscript received 29 Sep 80) pp 50-54

REUSHKIN, V. N., Moscow

[Abstract] A study was made of the restructuring of diurnal rhythms of concentration of certain electrolytes in a number of organs of rats in the process of adaptation of the animals to various conditions of habitation, as well as changes in the concentration under the influence of a single stress factor. It was found that approximately one day after development of the alarm reaction, caused by some external actions, reactivation of the neuroendrocrine system occurs with an increase in the energy output of the cells of the organs tested. The stimulus of the initial reaction included a sudden change in atmospheric pressure, exposure to general and local radiation, administration of drugs and other stimuli. In all cases, depending on the type and intensity of the one-time external action, a specific systematic adaptive reaction occurs preparing the organism for a repeat encounter with the same action one day later. This reaction includes activation of functional reserves, structural rearrangements related to the synthesis of adaptive enzymes and alteration of cellular structures, intended to minimize the stress on the organs and tissues in anticipation of the recurrence of the stress factor. References 34: 19 Russian, 15 Western.
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NEW ASPECTS OF FUNCTIONAL SYSTEM THEORY

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[Article by K. V. Sudakov, Institute of Normal Physiology imeni P. K. Anokhin, USSR Academy of Medical Sciences, Moscow]

[Text] Concepts of functional systems of the body were formed in the scientific school of P. K. Anokhin in the early 1930's (1932). These conceptions were refined for 50 years and finally acquired the elements of a definitive scientific theory. Theory of functional systems constituted the creative development of reflex theory and, in particular, of the materialistic views of I. P. Pavlov concerning higher nervous activity of animals. At the same time, a superficial analysis could make it appear that theoretical conceptions of self-regulating functional systems, whose activity provides for various adaptive results that are beneficial to organisms, deny to some extent the universality of the reflex principle, particular in interpreting complex forms of human and animal purposeful activities. Nevertheless, P. K. Anokhin himself repeatedly stated that dynamic organization of functional systems does not deny reflexes as physiological phenomena. On the contrary, he stressed, the reflex arc, as the structural foundation of all reflex activity, is organically contained as a component at the stage of afferent synthesis and construction of effector action by systemic organization of purposeful behavioral acts (P. K. Anokhin, 1973).

At the same time, unlike the reflex, which is the organism's reaction to some stimulus in all of its forms, functional systems, each of which may dynamically combine the same organs and tissues to achieve adaptive results beneficial to the organism, have a number of new properties. They not only react to exogenous stimuli, but respond on the feedback principle to diverse shifts in the controlled or vitally important result. Moreover, anticipatory reactions to real events are formed in them, and there is also comparison (correction) of the achieved result to the current needs of the organism. Moreover, the operational architectonics of functional systems differ substantially from the structure of the reflex arc. They include components wanting in the reflex arc, such as afferent synthesis, decision making, acceptor of results of action and, finally, the result of action and constant assessment thereof by means of feedback. Finally, the reflex principle signifies progressive advancement of a stimulus over the reflex arc from receptors to the effector. In contrast, functional systems operate on the self-regulation principle.

The main theses of functional system theory were formulated by P. K. Anokhin in several of his publications (P. K. Anokhin, 1968, 1970, 1971, 1980).

We shall discuss here the new theoretical and applied aspects of creative development of functional system theory, which were formed in the scientific school of P. K. Anokhin after his death. It should be stressed that development of the theory did not deal with its substance. The basic principles of functional system theory remained unchanged. Development was referable to issues that were not previously included in the area to which P. K. Anokhin paid attention, as well as experimental definition of general theoretical theses.

Principle of system quantization of animal and human behavior: Toward the end of his life, P. K. Anokhin expounded the ideas of "inscription" of living beings in the time and space continuum of the world around them (P. K. Anokhin, 1970). At the same time, he indicated that special, most vital stimuli that satisfy, for example, the main biological needs of animals, render discrete the time and space continuum around them. P. K. Anokhin believed that many cerebral reactions occurred in the nature of anticipatory excitation with regard to these vital stimuli.

The general biological conceptions of P. K. Anokhin about the fact that living beings were "inscribed" in the exogenous time and space continuum were developed in the principle of systemic quantization of behavior, which we formulated.

As we know, in general quantization signifies discreteness of any process. Quantization of behavior is also related to separation thereof into different fragments. According to the conceptions we are expounding, the entire continuum of behavior of any living being, from birth to death, can be separated into discrete "quanta," each of which is formed by some need of the organism and leads to satisfaction thereof to varying extents. Failure to meet a prime and, particularly, biological need usually means death to the individual and, in the case of sexual needs, extinction as a species. When a need is satisfied, the appropriate "quantum" of behavior terminates and the behavior of an animal is determined by another need, which forms the next "quantum" of behavior, etc.

Systemic "quanta" of purposeful behavior include formation of the appropriate internal need, appearance of dominant motivation on its basis, purposeful activity to satisfy this need, stages and ultimate results of activity, constant evaluation thereof by the organism by means of feedback.

Such "quanta" of behavior can be constructed, as we see it, on the basis of both biological and social (particularly in man) needs. The distinction of social "quanta" of human mental activity is that satisfaction of mental needs of man can be deferred to the distant future. There may be completed "quanta" of biological and other psychological needs between this psychological need and its satisfaction.

Each "quantum" of purposeful behavior, from the standpoint of central organization, has an isomorphic systemic architecture and includes the central mechanisms of afferent synthesis established by P. K. Anokhin, decision making, formation

of the system for predicting result parameters meeting the dominant need--acceptor of result of action, mechanisms of efferent synthesis, multiparameter purposeful action itself and, finally, evaluation of achieved results by comparing feedback from parameters of results achieved to acceptor of action result.

Thus, systemic quantization of purposeful behavior occurs on the self-regulation principle, by means of constant assessment of intermediate (stage) and end results satisfying the prime needs with feedback.

In recent years, we expanded the conceptions of needs that form the corresponding systemic "quanta" of behavior. In addition to biological or metabolic needs, which form the biological motivations of animals and man, and on this basis adequate purposeful activity, one must also bear in mind flock [herd] or zoosocial needs of animals. These needs determine the relations between specimens in a herd, purposeful behavior of the herd as an entire population.

The social needs of man should be singled out; they are determined by interaction between people in work and social groups in societies differing in economic systems.

Among the numerous needs of man, we can single out in particular the purely ideal mental needs that are conceived in brain structures under the influence of synthesizing stimuli due to metabolic needs and effects of the habitat and, primarily, the social environment. Expressly these needs distinguish man appreciably from animals, creating the supremacy of genuinely human social incentives lacking in animals. The area of activity of animals is limited to biological needs.

With development of our conceptions of the needs of living organisms there was also expansion of our knowledge and properties of results of behavioral acts to meet these needs. The question arose of quantitative parametrization of results, which dynamically formed the different functional systems of the organism.

Proceeding from the property of multiparametric nature of any need, it became necessary to consider any result of behavioral activity in the same way as a multiparametric factor meeting various aspects of the same need. Thus, each result of behavioral activity should be assessed from the standpoint of parameters that satisfy metabolic needs of an organism and communities (physical, chemical, biological properties), as well as the "ideal" parameters, which elicit specific emotional sensations in man and animals. In the case of man, parametrization of the results should include verbal or vocal parameters involved in his abstract and logical activity.

The conceptions we are expounding about systemic quantization of behavior do not preclude sporadic reactions of animals to exogenous stimuli. Here, one observes temporary impairment to some degree or other, of relatively stable processes of self-regulation of various somatovegetative functions of the individual with subsequent return to a new stable state.

Each "quantum" of behavior is constantly subject to the effects of various physical, chemical, biological and social exogenous factors, as well as

interaction with them. Some of these factors are instrumental in satisfying the prime dominant needs of living beings, while others are a hindrance.

At the same time, the reactions of living beings to exogenous stimuli depend appreciably on the initial state of an animal, on whether the corresponding need is present or absent. The latter always emerges as a sort of "filter," determining the selective attitude of living things to environmental factors. A need always determines the purposeful activity of living beings.

In each "quantum" of purposeful behavioral activity, on the basis of genetic and individually acquired memory mechanisms, there is anticipatory programming of specific properties of results meeting the prime needs of an organism. Such programming is determined by mechanisms of the acceptor of result of action of each functional system that forms the appropriate "quantum" of behavior. It is expressly with these mechanisms of the acceptor of action result, which anticipate real events, that there is constant comparison of parameters of achieved results in the course of animals' purposeful activity, on the self-regulation principle.

We (I. V. Sudakov, 1971) have developed conceptions of rigid and dynamic programming of results of behavioral activity. Rigid programming is inherent in inborne, so-called instinctive forms of behavior. It occurs under relatively stable living conditions and is characterized by the fact that the animals must achieve several intermediate results and receive reliable information about them in order to reach the required end results. If there is no satisfactory information about the success of any, even intermediate, result of activity, the instinctive behavioral act is repeated many times, resembling a broken record, until this result is achieved. In the case of dynamic programming of behavior, which is inherent in any form of animal learning under changing living conditions, there is formation of the temporal associations established by I. P. Pavlov between specific environmental stimuli and reinforcement. In this case, behavior may occur even in the absence of intermediate results, "bypassing" them. Dynamic programming of behavior is thus characterized by a more ramified and richer system of anticipation of the required result, in which intermediate results are not necessarily considered to reach the end result.

In recent years, we began to consider the possiblity of formation of so-called mental functional systems, particularly in man. They are formed on the basis of the most varied instructions, including various forms of general or special (musical, artistic, etc.) education. The result of activity of such functional systems could be meaningful concepts contained in instructions or resultant support words designating the results of various forms of behavioral activity. A certain emotional state--positive or negative emotions--may also result from a mental functional system. For example, a lecture delivered to students at no monetary charge may be rewarded by the emotional or simply socially significant satisfaction of the instructor. Mental functional systems control and determine human behavior. The results of man's behavioral activity are constantly compared to the results programmed by the activity of mental functional systems.

It should be stressed that the conceptions of mental functional systems are only beginning to be developed by us. However, one would think that expressly

mental functional systems constitute the foundation for man's abstract activity, which distinguishes him so strikingly from animals.

Conceptions of systemic quantization of behavior were developed in the studies of Yu. A. Fadeyev (1978), V. B. Shvyrkov (1978) and V. V. Andrianov (1976), which dealt with the study of impulsation activity of individual neurons in different parts of the brain at different stations of instrumental food-obtaining and defense behavior of animals. These studies revealed that there are neurons among the neuronal populations of different parts of the brain that are involved, by means of various changes in background impulsation, in all stages of quantum food-obtaining or defense behavior. They change their impulsation under the influence of conditioned signals, at the time an animal makes a decision for action, in the process of effecting purposeful activity proper, while waiting for reinforcement and, finally, during reinforcement. In addition to such "multifunctional" neurons, we discovered specialized neurons whose background activity changes only at certain stages of purposeful behavior of animals.

In the course of repetition of the same "quanta" of resultative behavior, the plastic properties of individual neurons can be demonstrated: they can alter their participation in some stage of purposeful behavior.

In the course of developing the above-mentioned conceptions, V. V. Andrianov (1979) demonstrated that the chemical sensitivity of the same individual cerebrocortical neurons of animals to neuromediators changes at different stages of purposeful behavioral acts.

We believe that these studies open up new prospects in research on higher nervous activity of animals. Unlike the study of animal reactions to various exogenous stimuli, including conditioned reflex ones, it is becoming possible to examine the neuronal mechanisms of purposeful activity of animals and man, activity that has an active effect on the environment, overcomes obstacles on the way toward satisfying the prime needs of living beings.

At the present time, several staff members at the institute (B. V. Zhuravlev, 1978; N. A. Shvyrkova, 1979, 1980; V. F. Volkov, 1980; L. A. Grebenyuk, 1980) are studying neuronal activity under conditions of free animal behavior at different stages of achieving results of vital importance.

The principle of systemic quantization of behavior found broad application in studies of professional performance of man, for example, workers at the Khromatron Plant (K. V. Sudakov, 1979; G. V. Ryzhikov et al., 1981), as well as purposeful activity of athletes (G. Ts. Agayan et al., 1978, G. Ts. Agayan, 1981). From the standpoint of systemic quantization of behavior, it is possible to separate the productive [work-related] process into similar "quanta" with intermediate and end results and, using telemetry and computers, determine the price, in terms of changes in physiological parameters, for each individual to achieve the same productive result. G. V. Ryzhikov et al. analyzed the dynamics of somatic and autonomic parameters of workers in the course of assembly work, which consisted of assembling small parts by means of spark welding. The studies were conducted on newcomers learning industrial professions, as well as women workers with tenure of 1 to 4 years. In these studies, telemetry was used to record the EKG, respiration and EMG.

In this case, the systemic "quantum" while assembling parts included several intermediate results: taking a cylinder in the left hand, placing it on a pin [rod], taking with the right hand a plate or angle, which are several times smaller than the cylinder, applying the plate to the surface of the cylinder, welding in several points, removing the cylinder from the rod and putting aside the assembled part. This "quantum" was assessed for each subject primarily by time.

Each individual "quantum" was distinguished on the basis of electromyographic parameters. The EMG was derived from the second or third finger of both hands using special electrodes. The site of application of electrodes was changed specifically in accordance with the operation to be performed. Dynamics of the EKG and respiration were examined in relation to each operation.

Among the operations studied, a distinction was made between the main (holding plate on the surface of the cylinder and the welding process) and ancillary ones (taking the cylinder and tossing the assembled item). These operations were performed in seconds and fractions of a second. For example, the women spent less than 1 s on each microwelding operation.

As the main characteristics of the parameters studied, use was made of their mean value, standard deviation and value of coefficients of cross-correlation. The criteria of Student and Fisher were used to compare similar parameters during assembly of different items (10, 20, ..., 50, 100 items per group). As a result, the directional changes when performing the main and ancillary operations were demonstrated.

As shown by the studies, one group (70% of the novices and all skilled workers) presented a slower heart rate during performance of the main operations and when changing from an auxiliary one to a main one, whereas during performance of ancillary operations it increased by 6-10/min. In 30% of the novices, on the contrary, heart rate increased by 12/min when performing the main operations and decreased by 5-12/min during ancillary operations.

Analysis of the changes in heart and respiration rates of skilled workers revealed that there were regular changes during performance of both main and ancillary operations, as in most beginners.

One of the individual distinctions was the lack of synchronization of changes in heart and respiration rate in a number of subjects. By the end of the training period, most workers had welded several spots and tossed an assembled item within one respiratory cycle. The relative frequency of such "productive" periods of respiration varied in different workers, constituting 40 to 75% of all respiratory cycles.

These individual changes in autonomic parameters of workers while performing the same operation are unquestionably important to a description of their professional performance. In this regard, the question arises as to which of the demonstrated changes characterize optimum physiological processes and which are referable to undesirable ones (bordering on disturbances). This question is the subject of future studies. However, even now, such studies have made it possible to objectively demonstrate the parts of the work involving individual tension, as well as to effect objective vocational screening.

It has become possible to study purposeful activity of sportsmen from a different angle because of conceptions of systemic quantization of behavior.

We analyzed the systemic mechanisms of somatovegetative parameters of marksmen in the course of firing a shot. In this case, the sportsmen's behavioral "quantum" included assuming erect position, the aiming process, pressing on the trigger, firing and assessing the achieved result. Studies were made of cross-correlation parameters of somatovegetative functions at different resultative stages of this "quantum" of behavior.

We developed a multichannel system to record motor activity of sportsmen, combined with various autonomic parameters, which enables us to record stability of stance, weapon, release of trigger, respiration and EKG. The performance of the athletes was divided into several subsystems directed at both the intermediate and end athletic result. The motor subsystems are: a) holding an erect position; b) keeping the weapon stable; c) pulling the trigger. The autonomic subsystems are: a) respiration, b) cardiac function.

The following were used as criteria for assessment of intermediate results: reduction of area under curve (i.e., minimization of integral) for stabilographic characteristics; smoothness and achievement of peak value for the curve of pulling the trigger; changes in heart rate (HR) and dynamics of respiration during the phase of firing the shot for autonomic parameters.

We assessed as the result the time of the entire shot and location of the bullet trace on the target in absolute numbers, from 1 to 10.

The most important stage of marksman performance is referable to the last microseconds of firing the shot. At this time, the HR increases (from 60 to 110/min), which is not infrequently associated with breath-holding. As a rule, expert marksmen do not hold their breath more than twice when preparing to fire, otherwise, as shown by our observations, the end result is poorer. Moreover, in experts, as opposed to beginners, respiration remains relatively rhythmic at all stages of performance. Thus, individual differences were established in somatovegetative parameters of sportsmen referable to different classes, and their influence on the end result was shown. The systems approach made it possible to define the distinctions of the somatovegetative "portrait" of beginners and highly skilled sportsmen.

The above conceptions reflect the principle of successive systemic quantization of behavior. In addition, Ye. A. Umryukhin (1980) of our institute formulated in recent years and is continuing to actively develop the new principle of hierarchic quantation of mental result-producing activity of man. This principle postulates that, when setting a prime goal and striving to achieve it, man may perform several "quanta" of activity that are subordinate to the main task.

Development of functional system theory touched upon definition of conceptions about mechanisms of central organization of purposeful behavioral acts. First of all, there was development of the concrete mechanisms of afferent synthesis, acceptor of action result and efferent synthesis.

The new conceptions also affected the study of molecular organization of systemic functions.

Afferent synthesis: The mechanisms of afferent synthesis have been expanded, primarily due to investigation of the properties of motivational stimulation. New facts were established from studies of mechanisms of biological motivations, with regard to changes in convergent and neurochemical properties of individual neurons in different parts of the cerebral cortex under the influence of motivational stimuli (A. V. Kotov, 1973; A. V. Lisitskiy, 1976; V. V. Andrianov ,1979; S. N. Khayutin, 1972). It was shown that dominant motivational excitation leads to a change in sensitivity of individual neurons of the brain to neuromediators and neuropeptides.

The studies of V. G. Zilov (1979) demonstrated that motivations differing in biological quality are characterized by different integration of structural and chemical interactions of cortical-subcortical elements. He established that biological motivations are implemented by homologous mediators; however, integration of different mediators, for example, norepinephrine, dopamine and serotonin, and of food and defense motivation are not the same.

It was shown that the brain has compensatory capabilities when the motivational structures of the hypothalamus are destroyed. Analysis of cortical-subcortical relations under such conditions suggests that compensation of motivational stimulation is based on newly formed integration of cortical-subcortical elements of the brain, which is characterized by other than usual chemical properties.

In recent years, several studies of institute staff members were concerned with the behavior of animals in the presence of artificially increased biological motivation, as well as alcoholic motivation (K. V. Sudakov et al., 1980).

Experiments involving intensification of dominant motivation (A. V. Kotov, 1981) revealed the distinctions of alteration of systemic mechanisms corresponding to purposeful behavioral reactions. A working hypothesis was expounded to the effect that compensatory reactions to "excessive" activation of pacemaker regions of the hypothalamus are based on specific reintegration of motivation-originating structures of the limbic-reticular complex. A. V. Kotov advanced the hypothesis that the mechanisms of decision making and evaluation of the adaptive significance of the results of purposeful activity are the least resistant in pathological processes of higher nervous activity.

At the present time, the efforts of several members of the institute's staff are directed toward identifying the molecular mechanisms of motivational stimuli. It was found that angiotensin II and bradykinin are involved in the formation of defense reactions of animals and self-stimulation reactions.

A hypothesis was expounded and is being developed experimentally concerning the role of endogenous kinins, vasoactive oligopeptides in formation of motivational excitation differing in biological quality (K. V. Sudakov, 1980; V. V. Sherstnev and V. I. Badikov, 1978).

Acceptor of result of action: The studies of A. I. Shumilina and G. N. Rychkova (1978), and R. M. Saliyeva (1977) demonstrated appearance of anticipatory excitation in different structures of the brain in response to conditioned stimuli in the form of negative electric wave (ε wave, according to Walter) on the example of development of conditioned food reactions in dogs.

T. N. Loseva (1966) discovered that emergency nonreinforcement of a developed conditioned defense reflex elicits appearance of slow high-amplitude waves on the EEG (phenomenon of corticosubcortical reverberation of stimuli, according to A. I. Shumilina) and volleys of activity of individual neurons of the sensorimotor cortex.

We (K. V. Sudakov, 1978) expounded the hypothesis of an imprinting mechanism for the acceptor of result of action.

In 1974, we advanced the conception that, along with an energetic component, consisting of ascending activating influences of subcortical structures, there is a guiding component--anticipatory excitation--in the structure of motivational stimulation. This component constitutes the acceptor of action result, which programs by means of genetic and individually acquired mechanisms the properties of the result that satisfies the dominant need upon which motivation is based (K. V. Sudakov, 1974).

According to the imprinting hypothesis of formation of the acceptor of action result, motivational stimulation of any quality effects selective activation of neuronal elements on different levels of the brain into specific corticosubcortical integration. These stimuli spread to effector neurons over the pyramidal tracts. Concurrently, copies of effector commands, following the anticipation principle, excite complexes of intercalary neurons on different levels of the brain in a generalized manner through collaterals of the pyramidal tract. Feedback from parameters of the results of action comes expressly to these neurons. Each result, we believe, leaves a distinctive impression, a trace (engram) on the neuronal structure of the acceptor of action result in motivational excitation. This impression of properties of results is what constitutes the distinctive imprinting. Expressly this trace, imprinted by prior reinforcements, is reproduced according to the anticipatory principle in the form of a specific corticosubcortical constellation of stimuli whenever a given need is formed and the corresponding motivation appears.

In the case of similar reinforcement, this trace may persist for a long time. When the parameters of reinforcement are changed, it undergoes dynamic change, reflecting new properties of the latter.

Recently, the studies of several of the institute staff members discovered, in the structure of dominant motivation, a cellular correlate of the process of anticipation of reinforcement parameters. It was established that, in the presence of dominant motivation, a certain part of neurons on different levels of the brain presents volley activity, which immediately changes to regular activity when the organism is submitted to reinforcement of the appropriate parameters (B. V. Zhuravlev and K. V. Sudakov, 1979; B. V. Zhuravlev and I. Yu. Orbachevskaya, 1980).

It was discovered that neurons of the cortex and subcortical structures participate differently in processes of prediction and evaluation of the results of purposeful behavioral reactions. A "declining gradient" of involvement in these processes of neurons, from stem structures to the cerebral cortex, was demonstrated on the example of food-related activity.

It was recently established that individual oligopeptides, for example, gastrin and steroid hormones, are involved in formation of volley activity (V. P. Belyy, 1980; B. V. Zhuravlev and I. Yu. Orbachevskaya, 1980).

Systemogenesis of the behavioral act: As we know, P. K. Anokhin interpreted systemogenesis as the selective maturation of different functional systems and parts thereof in the pre- and post-natal period. Studies of institute staff members revealed some new aspects of systemogenesis.

In recent years, new theoretical conceptions of population systemogenesis were formed at our institute (N. N. Kokina, 1976). According to these conceptions, certain elements of cell populations form special tissues according to systemic patterns, which are under the control of adaptive results that are beneficial to the organism. Similarly, several individuals' combined behavior is involved in achieving results that are beneficial to herd activity.

Conceptions of population systemogenesis have extended to the patterns of establishment of herd relations among mammals, in particular, moose in their natural habitat (Ye. M. Bogomolova and Yu. A. Kurochkin, 1978). Direct observations of newborn moose in their natural habitat established that the first satisfaction of a given biological need is the critical moment for formation of the action result acceptor. It is expressly at the time of achieving the first result that the main parameters and means of achieving it instantly, i.e., from the first time, are remembered and firmly fixed in the animal's memory in the form of the corresponding action result acceptor. In this sense, one can also speak again of an imprinting mechanism of formation of the acceptor of action result.

Along the lines of further development of systemogenesis theory of P. K. Anokhin, the conception of systemic periodization of development was advanced, on the basis of experimental data from studies of heterogeneity of maturation of neuroblasts, according to which there are periods of development of different functional systems, which are genetically strictly programmed, and periods of deployment of the genetic program under the influence of various environmental factors (N. N. Kokina, 1976).

N. N. Kokina is developing new conceptions of systemogenesis as a single process covering the entire life cycle of animals and man in the postnatal period and maturity, from birth to aging and death.

The conceptions of systemic quantization of behavior made it possible to advance the concept of systemogenesis of the behavioral act (K. V. Sudakov, 1979). According to these conceptions, somatovegetative implementation of similar "quanta" changes in the course of development of a skill, its consolidation, automation and extinction.

A change in somatovegetative parameters in the course of learning by man of an occupational skill was demonstrated in several works by our colleagues (G. Ts. Agayan, 1981; O. Ya. Bokser and K. V. Sudakov, 1981; A. N. Vazin et al., 1978; G. V. Ryzhikov et al., 1981).

Analysis of data obtained in the course of worker training revealed that, as training progressed, there was a decrease in frequency of fluctuation of heart rate during assembly of each item; the changes in HR and respiration rate became more stable. At the start of training, during repeated similar work operations the heart rate and respiration rate are different. As training progresses, the variability of these parameters diminishes during performance of all operations. The greatest variability of these parameters was noted when performing operations involving placement of a thin plate on a cylinder and during welding. At the end of the training, the highest incidence of appearance of maximum HR and respiration rate was referable to ancillary operations and the lowest, to the main operations. Individual distinctions of the learning process were manifested not only by the dynamics of HR and respiration rate, but tracings of series of time intervals between typical potentials of the fingers. As a rule, at the early stages of training there was no synchronization of changes in HR and respiration; it persisted in some workers even at the late stages of training.

As we have indicated above, the time spent to assemble one item was the main indicator of the learning process for assembly workers (women). As shown by the studies, skilled workers spent an average of 3.5-4.5 s on one item. Beginners spent 12-14 s on the same item at the start of training, and the time decreased to 4-5 s at the end of training.

As training progresses, there is a change in correlation between HR and all performed operations. At the start of training, the coefficients of correlation did not exceed 0.3-0.4. Thereafter, the correlation between HR and operations increased. At first it increased between HR and successively performed ancillary operations (tossing, picking up parts); the coefficient of correlation between HR constituted 0.55-0.9 for 70% of the subjects. In the same group, there was a statistically significant increase in value of the coefficient of correlation between the main operations (welding at different points) at the next phase of training. The lowest correlation was noted between main and ancillary operations: between placement of the cylinder and picking up the plate or placement of the cylinder and start of welding. As performance became more automatic and workers spent less time to achieve the result, there was a significant increase in coefficients of correlation between HR for the sequence of ancillary operation--main operation.

The HR changes were regular in workers with tenure of 1-4 years. The greatest differences in HR were noted when changing the type of operation (from main to ancillary and vice versa), whereas HR changes were minimal when performing the same type of operation.

As skill was gained, there was stabilization of HR and respiration rate. During assembly of most items, the HR was related to the final periods of assembly of parts.

On the basis of these data, it can be concluded that in the course of appearance and consolidation of each systemic behavioral act there is a change in significance of the different intermediate results. At the start of training, performance of the main operations acquires more importance than ancillary ones. When performance becomes automatic and shorter time is required for a systemic result, it is no longer the different intermediate results, but the end ones related to complete assembly of the item that acquire first and foremost significance.

The dynamics of changes in somatovegetative implementation of the system of purposeful behavior of marksmen in the course of developing skill, as we have mentioned above, were observed by G. Ts. Agayan in his studies.

The dynamics of somatovegetative and electroencephalographic changes during developing of conditioned food reactions in dogs were studied by V. A. Shidlovskiy (1969) and R. M. Saliyeva (1976).

In the experiments of R. M. Saliyeva, the dogs were trained to lie on a stand in the intervals between conditioned stimuli, and they ran to the feeder only when the dispensing mechanisms began to operate ["rattle"]. With the 2d-4th food reinforcement, the animals presented a markedly faster respiration rate in response to a conditioned stimulus 0.4-0.7 s later. With further reinforcements, the heart rate became faster several tenths of second after the respiratory changes. Against this background, further reinforcement caused appearance of salivation and a motor reaction, in the form of turning the head in the direction of the bell or feeder.

To activate the motor component, the procedure of prolonging the isolated effect of the conditioned stimulus was used up to the time the dogs came near the feeder. As a result, the latency period of the motor reaction gradually diminished to 2-3 s.

In the course of subsequent reinforcements, the EEG of different parts of the cerebral cortex, which were previously activated by the conditioned stimulus, showed appearance of a slow, negative (4-8 s) "anticipation wave." At first, it was demonstrable in the temporal cortex, then in the occipital cortex and subcortical structures (hypothalamus and reticular formation).

The special studies of A. N. Vazin, A. P. Sorokin and K. V. Sudakov (1978) proved the dynamic involvement of various respiratory and cardiovascular parameters in implementation of the result-producing activity of animals and man, and adaptation to physical loads. Examination of athletes during graded physical exercise using the systems approach made it possible to detect early forms of compensated cardiac insufficiency, as well as to determine the optimum load for the training process (A. N. Medelyanovskiy, 1981).

Studies of systemic mechanisms of emotional stress, which were conducted at our institute, acquired practical importance. From the standpoint of functional system theory, emotional stress occurs whenever man, or even an animal, cannot satisfy prime biological or social needs for a long time or properly for different reasons, i.e., cannot achieve results of vital importance. It is

expressly under these conditions of emphatically conflict situations that some individuals can develop varying degrees of somatovegetative disturbances.

The studies of our team are directed primarily toward systemic mechanisms of resistance of cardiovascular functions of man and animals to psychoemotional stress. We have demonstrated the role of positive emotions, motor activity, modulated electromagnetic fields of specific parameters, as well as some oligopeptides in enhancing resistance of cardiovascular functions of animals to acute emotional stress (L. S. Ul'yaninskiy et al., 1976, 1979; S. K. Sudakov, 1980; Ye. A. Yumatov et al., 1980).

Thus, development of functional system theory is continuing. It not only pertains to theoretical issues, but a number of applied aspects, and it opens up new and promising routes of research.

BIBLIOGRAPHY

1. Agayan, G. Ts., "Study of Systemic Mechanisms of Somatovegetative Implementation of Purposeful Human Activities," doctoral dissertation, Moscow, 1981.
2. Agayan, G. Ts., Polyantsev, V. A. and Sudakov, K. V., in "Vsesoyuznaya konf. po fiziologii i biokhimii. 15-ya" [15th All-Union Conference on Physiology and Biochemistry], Baku, 1978, p 6.
3. Andrianov, V. V., "Analysis of Discharge Activity of Cerebrocortical Neurons at Successive Stages of Purposeful Behavior," candidatorial dissertation, Moscow, 1976.
4. Idem, ZH. VYSSH. NERVN. DEYAT., No 6, 1979, pp 1306-1308.
5. Anokhin, P. K., "Biology and Neurophysiology of Conditioned Reflexes," Moscow, 1968.
6. Idem, in "Yezhegodnik BME" [Great Medical Encyclopedia Annual], Moscow, Vol 1, 1968, pp 1300-1322.
7. Idem, USPEKHI FIZIOL. NAUK, Vol 1, No 1, 1970, p 19.
8. Idem, "Basic Issues of General Theory of Functional Systems," Moscow, 1971.
9. Idem, VOPR. FILOSOFII, No 6, 1970, pp 107-118.
10. Idem, "Key Issues of Theory of Functional Systems," Moscow, 1980.
11. Belyy, V. P., PROBL. ENDOKRINOL., No 3, 1980, pp 56-62.
12. Bogomolova, Ye. M. and Kurochkin, Yu. A., in "Stress i adaptatsiya" [Stress and Adaptation], Kishinev, 1978, pp 290-291.

13. Bokser, O. Ya. and Sudakov, K. V., USPEKHI FIZIOL. NAUK, Vol 12, No 1, 1981, pp 3-31.

14. Vazin, A. N., Sorokin, A. P. and Sudakov, K. V., Ibid, Vol 9, No 3, 1978, pp 133-148.

15. Zhuravlev, B. V., in "Mekhanizmy sistemnoy deyatel'nosti" [Mechanisms of Systemic Activity], Gor'kiy, 1978, p 46.

16. Zhuravlev, B. V. and Sudakov, K. V., ZH. VYSSH. NERVN. DEYAT., No 3, 1979, pp 643-646.

17. Zhuravlev, B. V. and Orbachevskaya, I. Yu., BYULL. EKSPER. BIOL., No 2, 1980, p 137.

18. Zilov, V. G., "Comparative Characteristics of Corticosubcortical Correlations in the Structure of Motivations Differing in Biological Quality," doctoral dissertation, Moscow, 1979.

19. Kelesheva, L. F., "Neurophysiological and Neurochemical Distinctions of Central Mechanisms of Alcoholic Motivation in Rats," candidatorial dissertation, Moscow, 1980.

20. Kokina, N. N., "Systemogenetic Patterns of Ontogenetic and Phylogenetic Formation of Neurons," doctoral dissertation, Moscow, 1976.

21. Kotov, A. V., "Interaction Between Food Motivation and Reinforcing Food Stimulation in Neurons of the Cerebral Cortex," candidatorial dissertation, Moscow, 1973.

22. Lisitskiy, A. V., "Role of Motivational Food Stimulation in Convergent Properties of Neurons of the Sensorimotor Cortex," candidatorial dissertation, Moscow, 1976.

23. Loseva, T. N., "Neuronal Organization of Orienting-Exploratory Reaction Arising With Emergency Nonreinforcement of Conditioned Reaction," candidatorial dissertation, Moscow, 1976.

24. Medelyanovskiy, A. N., USPEKHI FIZIOL. NAUK, 1981 (in press).

25. Ryzhikov, G. V. and Meshcheryakov, V. P., FIZIOLOGIYA CHELOVEKA, No 2, 1980, p 230.

26. Saliyeva, R. M., "Multieffector Analysis of the Functional System of Food-Related Behavior," candidatorial dissertation, Moscow, 1977.

27. Sudakov, K. V., "Biological Motivations," Moscow, 1971.

28. Idem, in "Soveshchaniye po problemam vysshey nervnoy deyatel'nosti. 24-ye. Materialy simpoziuma" [Proceedings of Symposium, 24th Conference on Problems of Higher Nervous Activity], Moscow, 1974, pp 96-98.

29. Sudakov, K. V., in "Mekhanizmy sistemnoy deyatel'nosti mozga" [Mechanisms of Systemic Activity of the Brain], Gor'kiy, 1978, pp 122-125.

30. Idem, in "Vysshiye funktsii mozga v norme i patologii" [Higher Functions of the Brain Under Normal and Pathological Conditions], Leningrad, 1979, pp 92-116.

31. Idem, in "Vazoaktivnyye peptidy" [Vasoactive Peptides], Sofia, 1980, pp 31-33.

32. Sudakov, K. V., Kotov, A. V. and Kelesheva, L. F., DOKL. AN SSSR, Vol 246, No 1, 1979, pp 243-246.

33. Sudakov, S. K., "Analysis of Preventive Effect of Ultrahigh-Frequency Field on Dynamics of Acute Emotional Stress in Rabbits," author abstract of candidatorial dissertation, Moscow, 1981.

34. Ul'yaninskiy, L. S., Balashov, A. N., Gritsak, A. V. et al., BYULL. EKSPER. BIOL., No 11, 1976, pp 1288-1291.

35. Ul'yaninskiy, L. S., Stepanyan, Ye. P., Gritsak, A. V. et al., in "Vsesoyuznyy s"yezd kardiologov. 3-y" [Third All-Union Congress of Cardiologists], Moscow, 1979, pp 315-316.

36. Umryukhin, Ye. A., "Systems Analysis of Intuitive Learning in Man," doctoral dissertation, Moscow, 1980.

37. Fadeyev, Yu. A., "Systems Analysis of Impulsation Activity of Neurons of the Cerebral Cortex," doctoral dissertation, Moscow, 1978.

38. Khayutin, S. N., ZH. VYSSH. NERVN. DEYAT., No 6, 1972, pp 1248-1253.

39. Shvyrkov, V. B., "Systemic Organization of Neurophysiological Processes in Elementary Behavioral Act," doctoral dissertation, Moscow, 1978.

40. Shvyrkova, N. A., in "Printsipy i mekhanizmy formirovaniya funktsional'nykh sistem organizma" [Principles and Mechanisms of Formation of Functional Systems of Organisms], Moscow, 1979, p 147.

41. Idem, ZH. VYSSH. NERVN. DEYAT., No 3, 1980, pp 534-541.

42. Sherstnev, V. V. and Badikov, V. I., in "Mekhanizmy sistemnoy deyatel'nosti mozga," Gor'kiy, 1978, pp 153-158.

43. Shidlovskiy, V. A., in "Sistemnaya organizatsiya fiziologicheskikh funktsiy" [Systemic Organization of Physiological Functions], Moscow, 1969, p 422.

44. Shumilina, A. I. and Rychkova, G. N., USPEKHI FIZIOL. NAUK, No 1, 1978, pp 42-80.

45. Yumatov, Ye. A., Gekht, K., Skotselyas, Yu. G. et al., in "Vazoaktivnyye peptidy," Sofia, 1980, pp 44-45.

10,657
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PLASTIC PROPERTIES OF MOTIVATION AS PRIME COMPONENT IN SYSTEMIC ORGANIZATION OF PURPOSEFUL BEHAVIORAL ACTS

Moscow VESTNIK AKADEMII MEDITSINSKIKH NAUK SSSR in Russian No 2, Feb 82 (manuscript received 7 Apr 81) pp 17-21

[Article by A. V. Kotov and V. G. Zilov, Institute of Normal Physiology imeni P. K. Anokhin, USSR Academy of Medical Sciences, Moscow]

[Text] According to general theory of functional systems of P. K. Anokhin, motivational stimulation is a mandatory and prime component of any behavioral act, since "the behavioral act always satisfies some need of an organism, either nutritional or ideal" (P. K. Anokhin, 1968). It is not surprising that the architectonics of cortical and subcortical elements of the brain, which form certain motivations, the role of different structures in mechanisms of dissemination of motivational stimuli to neocortical regions, chemical mechanisms involved in various biological and social motivations of the organism continue to be the focal point for Soviet and foreign researchers. Thus, the school of P. K. Anokhin developed theses concerning the "pacemaker" nature of formation of motivational stimuli (P. K. Anokhin, 1968; K. V. Sudakov, 1971), that each motivation is constructed on the principle of dominant (K. V. Sudakov, 1971) and the hypothesis of energetic and guiding elements of motivational stimuli differing in biological quality (K. V. Sudakov, 1971). Moreover, numerous studies using microelectrode techniques demonstrated that motivational excitation is capable of appreciably enhancing reactivity and discriminating capacity of individual neurons of the brain with exposure to situational and reinforcing stimuli (S. N. Khayutin, 1972; A. V. Kotov, 1974; A. S. Sosnovskiy, 1974). As a result, data were obtained that are apparently indicative of the high plastic properties of dominant motivations, which enables the organism to operationally mobilize central and peripheral mechanisms in order to form and effect behavioral acts. At the same time, the question of plastic properties of motivational excitation within the whole brain and its role in alteration of purposeful behavioral acts have been little-studied.

Special experiments dealt with corticosubcortical correlations developing in the brain in the course of formation of motivations differing in biological quality: alimentary and defensive. Studies were made of involvement of dorsal parts of the hippocampus, mesencephalic reticular formation, different parts of the neocortex in development of food and defense motivation in rabbits submitted to electrostimulation and electrocoagulation of the corresponding motivation-generating parts of the hypothalamus. In addition to stimulation and destruction

of the brain structures under study, the experiments included analysis of the force of main EEG rhythms of different limbico-reticular structures and regions of the cerebral cortex.

It was found that development of defensive motivation in animals was characterized by significant increase in force of θ rhythm in frontal regions of the cerebral cortex, whereas appearance of food motivation was associated with primarily increase in α rhythm. Analysis of involvement of the dorsal hippocampus and mesencephalic reticular formation in dissemination of motivational stimuli over the cerebral cortex revealed that the ascending influences of the hypothalamic "alimentary center" of the lateral hypothalamus on the neocortex had more similarity to ascending reticular influences than hippocampal ones ($P = 0.25$ and $P>0.001$). At the same time, there was a statistically reliable coincidence of effects on activity of the frontal cortex of "avoidance centers" of the ventromedial hypothalamus and dorsal hippocampus (V. G. Zilov, 1980).

Studies of the nature of corticofugal influences on formation in animals of food and defense motivations revealed inhibitory effects of stimulating the frontal cortex and more complex influences of stimulation of the occipital region of the neocortex: inhibition of avoidance reactions and alleviation of food behavior (V. G. Zilov and S. K. Rogacheva, 1979). Analysis of changes in main EEG rhythms of motivation-generating centers of the hypothalamus revealed that the above influences of the neocortex on biologically different behavioral reactions were associated with specific patterns of electric activity of the "food centers" of the lateral hypothalamus and "avoidance centers" of the ventromedial hypothalamus.

Thus, the experiments revealed that motivation differing in biological quality (in this case, alimentary and defensive) is provided in animals by specific integration of cortical and subcortical structures of the brain (V. G. Zilov, 1980). Experiments with the use of pharmacological agents having different effects on corticosubcortical correlations confirmed this hypothesis, demonstrating in particular that each motivation is implemented by heterochemical mechanisms. It was established that inhibitory effects of different structures of the brain on excitability of hypothalamic motivation-generating centers were eliminated by M-choline- and dopamine-blocking agents, whereas alleviating effects were eliminated by α-adrenoblocking agents (V. G. Zilov, 1979). One would think that the demonstrated heterochemical involvement of different brain structures constitutes additional evidence of labile involvement of brain structures in processes of formation of motivational excitation.

In a special series of experiments on rabbits, electrolytic destruction of "hunger centers" of the lateral hypothalamus was performed bilaterally. Of the 24 rabbits submitted to this operation without intervention on the part of the experimenter to improve their condition, 12 survived. The others died on the 2d-4th day after electrocoagulation of "hunger centers" presenting signs of aphagia, adipsia, akinesia, diminished reactivity to tactile and nociceptive stimuli. The animals used in the experiment, whose food behavior and independent satisfaction of food and water needs were restored, nevertheless differed from intact rabbits in that they were less active and there was a particularly drastic decrease in number of orienting and exploratory reactions. There were

defects referable to the motivational aspect of behavior, as manifested by absence of active search for food by objectively hungry animals. The operated rabbits passively consumed feed only when in direct contact with it. A study of central mechanisms forming alimentary behavior of animals under such conditions revealed a new integration, primarily of cholinergic and dopaminergic structures of the brain (V. G. Zilov and S. K. Rogacheva, 1979). Thus, while intravenous injections of atropine (1 mg/kg) and droperidol (0.3 mg/kg) to intact animals eliminated inhibitory influences of the frontal cortex and dorsal hippocampus on development of food-related behavior, these effects of M-choline- and dopamine-blocking agents were virtually lacking in rabbits with bilateral destruction of hypothalamic "hunger centers." Other researchers have also reported change in chemical properties of central mechanisms involved in restoring food behavior when there is bilateral destruction of the lateral hypothalamus. Thus, injection in the blood stream of 2-deoxyglucose, which normally elicits increased food intake, did not stimulate food behavior of operated animals (Stricker et al., 1979). A spiroperidol-specific agent that blocks dopaminergic receptors diminished appreciably food intake by animals with destroyed hypothalamic motivation-generating centers (Heffner et al., 1977).

Our experiments involving bilateral coagulation of motivation-generating "hunger centers" of the lateral hypothalamus (V. G. Zilov and S. K. Rogacheva, 1981) should be considered proof of the compensatory capabilities of the brain. In the absence of motivation-generating hypothalamic "pacemakers," the animals could still satisfy their vital need for food by means of alteration of cortico-subcortical integrations, structural and chemical mechanisms of the brain, which is indicative of the GREAT PLASTICITY of processes involved in formation of motivational excitation.

Experiments involving the study of the nature of complex food-related instrumental behavior of rabbits in a T-shaped maze, with bilateral destruction of "hunger centers" of the lateral hypothalamus, served as new proof of this thesis (A. V. Kotov and S. M. Tolpygo, 1978). To receive food reinforcement, the animals were previously trained to move to the food compartment, in response to conditioned stimuli (light, sound) delivered in the starting compartment of the maze, through a special passage, and to receive a portion of feed in the right or left feeder. Filling the feeders depended on the nature of the conditioned signal (for example, light--left feeder, sound--right one). As a rule, by the 3d-4th day the animals had firmly acquired the food-obtaining skill and demonstrated a capacity to satisfy their need for food under such complicated experimental conditions. Bilateral electrolytic coagulation of the lateral hypothalamus (mean diameter of destroyed tissue 0.7 mm) led to general behavioral disturbances in the rabbits, including food behavior, as described above. However, the most remarkable thing was that the shortage of food motivation excitation was manifested the most graphically only under the usual upkeep conditions (vivarium), rather than in the T-shaped maze. Already on the 2d-3d day after destruction of the "hunger centers" of the lateral hypothalamus, against a background of severe akinesia, the rabbits displayed active orienting reactions in response to conditioned stimuli; on the 4th-5th postoperative day they ran actively to the food compartments and, finally, by the 6th-7th day there was complete restoration of the ability to choose the site of reinforcement in accordance with the nature of the conditioned

stimuli. These facts are indicative of the modulating influence of the environment on processes of formation of motivational excitation, as well as the mechanisms of implementation of purposeful behavioral acts.

This thesis was also confirmed in experiments dealing with group and individual food behavior of rats in artificially formed populations. Use of special criteria of individual food-searching behavior of animals (speed of running for food, sequence of approaches to feeder, number of victories and losses in fights for food, storing food, etc.) made it possible to distinguish leaders, subdominants and outcasts in each group of rats, i.e., to determine the hierarchic status of each specimen in the population. The established hierarchy of relations usually persisted throughout the period of preliminary observations, and it was generally stable (up to 2-3 weeks of observation). As shown by the experiments of Ye. I. Ivanov, which were conducted in the laboratory of physiology of motivation, Institute of Normal Physiology imeni P. K. Anokhin, USSR Academy of Medical Sciences, electric stimulation of the "hunger centers" of the lateral hypothalamus in animals occupying different rank positions in populations, but performed under individual conditions, elicited alimentary behavior at about the same values of stimulating current. The findings were different when the "hunger centers" were stimulated when the animals were kept in groups. The leader rats presented a tendency toward decline of thresholds of electrostimulation, in subdominants the thresholds showed virtually no appreciable change, and in the outcasts there was 3-4-fold increase in stimulation threshold, and often we were unable to demonstrate any food reactions. Thus, evidence was again obtained to the effect that situational afferentation, in this case zoosocial upkeep, had a most decisive influence on external manifestations of motivational stimulation and on formation of purposeful behavior.

However, a more interesting finding in our opinion was that the outcast rats, who were subject the most to the restraining effect of the environment, demonstrated various forms of nonalimentary behavior under group conditions in response to threshold (for individual conditions) alimentary stimulation of "hunger centers" of the lateral hypothalamus: grooming, orienting-exploratory reactions, cataleptoid states and even, sometimes, drinking behavior. It could be said that there was a sort of "extension" of alimentary motivational excitation beyond the limits of its biological specificity, which could occur only due to high dynamic properties of dominant motivation and its interaction with the flow of situational afferentation. Appearance of new, other than food-obtaining forms of purposeful behavior was observed in rats in the presence of artificially produced, prolonged domination of motivational alimentary excitation (chronic electrostimulation and repeated adrenergic chemostimulation of "hunger centers" of the hypothalamus) in animals occupying low ranking positions in the population. Thus, as a result of intensive stimulation of motivation-generating food centers, subdominant rats showed a drastic increase in their fighter qualities, demonstrating their aggressive behavior, which was directed against other members of the group, often not for the purpose of possessing food. Such an artificially created behavioral "portrait" enabled the subdominants to move to the rank of leaders and, what is the most important, to remain in this role even after discontinuing hypothalamic stimulation, for a long period of time (up to 1.5-2 months of observation). One would think that manifestation of aggressive behavior, transformed by the artificially induced

intensive need for food, in such animals was "imprinted" by other specimens in the group, which is what determined different hierarchic relations in the population.

The dynamic properties of motivational excitation were also demonstrated in studies of food-obtaining instrumental behavior of rabbits (A. V. Kotov and S. M. Tolpygo, 1978). These authors found that, in the course of learning instrumental food skills (tugging a ring with the teeth to receive food), along with proper behavioral acts (pulling ring with the teeth followed by intake of food), the rabbits displayed behavior that was outwardly inexpedient with regard to the dominating need for food (tugging the ring with the teeth with subsequent refusal of food). Most graphic was the fact that artificial intensification of motivational excitation under conditions of prolonged food deprivation or chronic electro- and chemostimulation of "hunger centers" of the lateral hypothalamus led in some rabbits, as in the preceding series of experiments, to appearance of behavior unrelated to food. In addition to satisfactory food-related instrumental skills, there was a drastic increase in number of grooming reactions, orienting-exploratory and sexual reactions, and cataleptoid states were observed. However, the most marked manifestation was the appreciable increase (by 300-400% in some cases) in quantity of instrumental behavior skills that did not end with intake of food. During several days of observation, such rabbits demonstrated an obsessive desire to effect an instrumental alimentary skill without subsequent intake of food, which was associated in some cases even with progressive weight loss. Beyond the context of systems analysis of an integral behavioral act, such activity could have been interpreted as a manifestation of motor stereotypy. However, upon analysis of such disturbances of instrumental behavior from the standpoint of the systems approach, it can be assumed that the above-described behavioral acts were relatively independent of a need for food, and that they were motivated independently, be it genetically inborn forms of behavior (grooming, orienting-exploratory and sexual reactions) or actually acquired instrumental skills. The above hypothesis of possibility of transformation of biological motivation by means of the dynamic properties inherent in animals in other forms of motivational excitation probably also explains the observed change in nature of purposeful behavior.

Experiments conducted together with L. F. Kelesheva and A. F. Meshcheryakov made it possible to obtain new data in this direction. In these experiments, male rats (Wistar and August) were submitted to prolonged deprivation of water, with 20% ethanol solution as the only source of liquids. After 30 days of satisfying their water requirements with 20% aqueous ethanol solution, most animls (up to 80%) preferred alcohol, rather than water, in a free choice situation. Moreover, electric stimulation of the "thirst centers" in the perifornix regions of the hypothalamus induced the search and intake of expressly alcohol, and not water, in such animals. This was indicative of appearance of new physiological properties in the motivation-generating "thirst centers" of the hypothalamus, which were capable to initiate specific alcoholic motivation in the animals under these conditions. Intrahypothalamic and intraventricular microinjections of several dipsogenic substances (hyperosmotic NaCl solution, acetylcholine, carbacholine, angiotensin II and others) demonstrated drastic changes in neurochemical mechanisms of thirst in such animals. In particular, new chemosensitive properties, as compared to intact rats, were discovered in the membranes of neurons of "thirst centers" with microionophoretic delivery to them of several neuromediators, cyclic nucleotides and neuropeptides. Thus,

prolonged water deprivation, on the one hand, and making ethanol available, on the other hand, caused formation of artificial alcoholic motivation in animals, which is not inherent in their biology. Comparative analysis of electroencephalographic structures of the limbico-reticular complex and various regions of the neocortex of intact rats and animals with formed attraction to alcohol revealed drastic differences in patterns of electric activity of these brain structures in the course of formation and expression of motivation for thirst and artificial alcoholic motivation.

The obtained facts again demonstrated the possibility of formation of artificial motivations in animals on the basis of inborn biological motivations. While they have a high energy, biological motivations are apparently not a conservative element of functional systems of purposeful behavior. As stressed repeatedly by P. K. Anokhin, already at the stage of afferent synthesis, dominant motivational excitation has elements of the action result acceptor and features of future reinforcement. And it is expressly this, along with the exceptional diversity of ambient stimuli, that provides for the extreme variability and changeability of behavior acts, to the extent of radical changes in objectives of behavior.

BIBLIOGRAPHY

1. Anokhin, P. K., "Biology and Neurophysiology of Conditioned Reflexes," Moscow, 1968.

2. Zilov, V. G., in "Problemy fiziologii gipotalamusa" [Problems of Physiology of the Hypothalamus], Kiev, Vyp 13, 1979, pp 53-60.

3. Idem, in "Konferentsiya po elektrofiziologii tsentral'noy nervnoy sistemy. 8-ya. Materialy" [Proceedings of 8th Conference on Electrophysiology of the Central Nervous System], Yerevan, 1980, pp 133-135.

4. Zilov, V. G. and Rogacheva, S. K., in "Sistemnyy analiz mekhanizmov povedeniya" [Systems Analysis of Behavior Mechanisms], Moscow, 1979, pp 258-273.

5. Idem, in "Fiziologicheskaya kibernetika" [Physiological Cybernetics], Moscow, 1981, pp 271-274.

6. Kotov, A. V., in "Vsesoyuznoye soveshchaniye po problemam vysshey nervnoy deyatel'nosti. 24-ye. Materialy" [Proceedings of 24th All-Union Conference on Problems of Higher Nervous Activity], Moscow, 1974, pp 71-73.

7. Kotov, A. V. and Tolpygo, S. M., in "Mekhanizmy sistemnoy deyatel'nosti mozga" [Mechanisms of Systemic Activity of the Brain], Gor'kiy, 1978, pp 77-79.

8. Idem, in "Razgruzochno-dieticheskaya terapiya psikhicheskikh i somaticheskikh zabolevaniy s nervno-psikhicheskimi narusheniyami i yeye fiziologicheskiye mekhanizmy" [Tension-Relieving and Diet Therapy of Mental and Somatic Diseases Associated with Neuropsychological Disturbances, and Physiological Mechanisms Thereof], Moscow, 1978, pp 175-177.

9. Sosnovskiy, A. S., in "Vsesoyuznoye soveshchaniye po problemam vysshey nervnoy deyatel'nosti. 24-ye. Materialy," Moscow, 1974, pp 94-96.

10. Sudakov, K. V., "Biological Motivations," Moscow, 1971.

11. Khayutin, S. N., ZH. VYSSH. NERVN. DEYAT., No 6, 1972, pp 1243-1259.

12. Heffner, T. G., Zigmond, M. J. and Strickner, E. M., J. PHARMACOL. EXP. THER., Vol 201, 1977, pp 386-399.

13. Strickner, E. M., Cooper. P. H., Marshall, J. F. et al., J. COMP. PHYSIOL. PSYCHOL., Vol 93, 1979, pp 512-521.

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SYSTEMIC MECHANISMS OF HUMAN SUBCONSCIOUS ACTIVITY

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[Article by Ye. A. Umryukhin, Institute of Normal Physiology imeni P. K. Anokhin, USSR Academy of Medical Sciences, Moscow]

[Text] Investigation of the mechanisms of man's subconscious activity is one of the important and promising problems of physiology. It can be assumed that it is expressly in this direction that the patterns will be discovered, which will make a substantial contribution to the solution of psychophysiological problems, i.e., they will enable us to define the physiological mechanisms of complex acts of human mental activity.

In recent times, many authors have turned to the study of various aspects of subconscious activity in man. As a rule, this involved analysis of different aspects of such activity, such as the link between conscious, unconscious processes and interhemispheric asymmetry (Sperry, 1969; Gazzaniga, 1970), unconscious acts of perception (E. A. Kostandov, 1969, 1978), electrophysiological correlates of conscious and unconscious switching of attention (Libet, 1966) and other phenomena. Apparently, with increase in number of studies of physiological mechanisms of man's subconscious activity, there is increasing importance of the systems approach to the study of these mechanisms (K. V. Sudakov and A. V. Kotov, 1978).

In this article, we have discussed the mechanisms of man's intuitive learning from the standpoint of functional system theory.

The experimental data, which served as the basis of the analysis that follows, were obtained by means of a new technique (Ye. A. Umryukhin, 1976), which made it possible to single out and examine the stages of human learning, which are characterized by intuitive memorizing and choice of correct action. This method was described in detail previously (Ye. A. Umryukhin, 1976, 1979), so that we shall limit ourselves only to a brief reminder about its main features. Four different signals, in the form of a circle 150 mm in diameter, illuminated by lights of one of four colors--green (S_4), red (S_3), light blue (S_2) and yellow (S_1)--were exhibited to the subject on a console. The same console had 5 buttons--4 along the edges of the

screen (d_1, d_2, d_3, d_4) and 1 auxiliary one in the center. In accordance with the instructions (which are discussed in detail below), before depressing one of the main buttons, the subject always had to depress the auxiliary one. As a result of this, the same hand movement from the center of the screen to a button corresponded to depression of each of the four main buttons. The color on the console would change upon depression of one of the four main buttons; the four signals always followed one another in the same order, forming a chain. After the change of the four colors, each of which occurred upon depressing the appropriate button as determined by the program in the instrument, a star would light up on the console for 1.2 [or 1-2] s, after which the first signal of the next chain would appear automatically. The instructions informed the subject that his objective was to light up the star many times and that to do this he had to select the correct buttons, i.e., the ones that change the color on the console and bring him closer to lighting up the star.

We used two programs in these studies, an auxiliary (P-1) and main (P-2) program. All of the tests started with the auxiliary program.

Because of the variable program of combinations of actions and signals in the P-1 program, deliberate memorizing of combinations was difficult. At the same time, the subjects were convinced that one could guess at the right buttons and thus be successful relying on an intuitive choice of actions.

After completing the P-1 program, the instrument was switched to the P-2 main one, which differed somewhat from the first one. In P-2, a complete change of all combinations of actions with signals occurred after every eight program chains, called a unit. In each unit, with each of the signals, one buttom turned on the next signal more often than the others (in the first unit, with S_4 button d_2 turned on S_3 6 times out of 8, with S_3 button d_3 turned on S_2 6 times out of 8, with S_2 button d_2 turned on S_1 6 times out of 8 and with S_1 button d_4 turned on the star 5 times out of 8). Thus, the subject could learn with each unit to choose these buttons; however, by changing the combinations of actions and signals after every 8 program chains, learning was interrupted and had to be started over in each successive unit. There were four different units in all in the program, which followed one another and formed the program cycle. In the studies, the subjects were presented with programs of two identical cycles without interruption, after which the program was terminated by automatically turning the console off.

After program P-2, the subjects were questioned about what they remembered concerning choice of actions and how they solved the problem. In 40 experiments, where the programs were run synchronously with recording thereof on an ink-writing instrument, we also recorded the subjects' autonomic reactions: respiration (with a carbon sensor around the chest and a thermistor attached near the nose), heart rate (HR) and galvanic skin response (GSR).

One of the main distinctions of the subjects' behavior when following the above program was that they learned to choose the correct actions, i.e., those more frequently reinforced, and at the same time this choice was made by many without being clearly aware of it, i.e., intuitively. Experimental data indicative of intuitive choice of action were discussed in detail previously (Ye. A. Umryukhin, 1978). The evidence offered there of the intuitive nature of choice of action at different stages of the program was based on analysis of the verbal accounts of the subjects about running the program, as well as comparison of the actual choice of actions when following the program with the possibility of recalling them verbally after termination thereof, as well as other data.

The main result was that, while the actual choice of correct actions was known ($P<0.01$) to exceed the random frequency in 85% of the subjects, only 15-18% reflected in their verbal reports deliberate memorizing of the program, other than at random. They were aware of the fact that, as a rule, entire chains of actions (from signal S_4 to the star) were most often in the form of geometric patterns, whereas the actual choice of correct actions was made by means of other mechanisms.

Having become convinced of the unconscious nature of choice of actions by the subjects at different stages of the program, we undertook an analysis of the mechanisms of this choice. Figure 1 illustrates the frequency of choice of action made by a group of subjects, which was obtained by averaging the first and second cycles for each 4 units of the P-2 program. Unit averaging was done with consideration of change in actions in the units, so that in each unit there was summation of frequency of choice of correct actions and other actions, with consideration of the changes therein in the unit. Analysis of distribution of choice of actions in two identical program cycles showed them to be unusually reproducible. This is indicative of manifestation in these frequencies of specific patterns and, consequently, of the possibility of detecting mechanisms of unconscious choice of actions from these patterns.

Analysis of autonomic reactions (GSR and respiratory reactions), which occurred in the subjects during performance of the program, as well as analysis of latency periods of choice of action at different stages of the program, was very helpful in demonstrating these mechanisms. Figure 2 illustrates the means for a group of 40 subjects for frequency of GSR appearing when signals S_4, S_3, S_2, S_1 and the star appeared, as well as latency period of choice of action after turning on each of the intermediate signals. These data show that the initial signal was singled out of the sequence of signals S_4, S_3, S_2 and S_1 leading to the star. It was found that the mean latency period for choice of the first action (with signal S_4) in the sequence leading to the star was significantly longer (3.17 ± 0.08 s) than the mean latency period of choice of actions when other signals were turned on (2.39 ± 0.06 s; $P<0.001$). Moreover, the GSR appeared much more often at the moment of turning on signal S_4 (66%) than at the times when the next signals were turned on in the sequence leading to the star (34%; $P<0.001$).

Reaching the star could also be distinguished from the frequency of autonomic reactions. At this time, there was a respiratory reaction of the "sign of relief" type--deep inspiration and expiration (81% of all such reactions), as well as GSR in 45% of the cases.

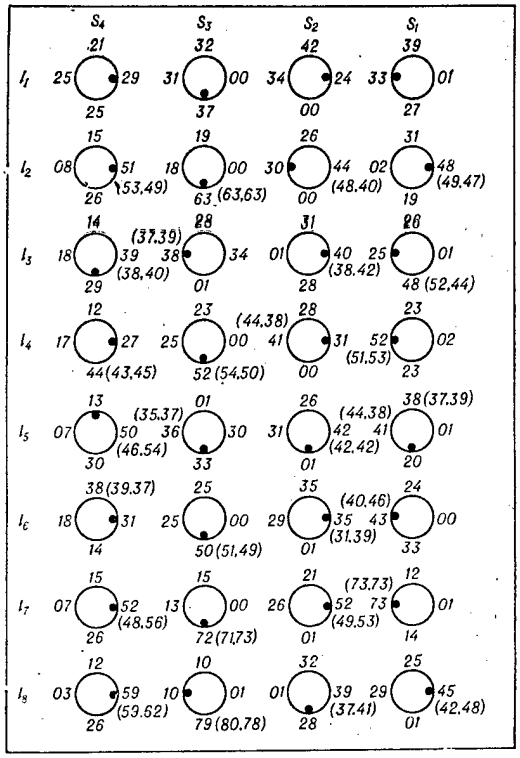

Figure 1.
Frequency of choice of actions by a group of 200 subjects on program P-2. Circles represent the subject's console. The location of the correct button is shown by a black dot. The figures on the top refer to frequency (%) of choice of corresponding button in first cycle and the bottom ones, in the second cycle; l_1-l_8 are the chain numbers for one unit

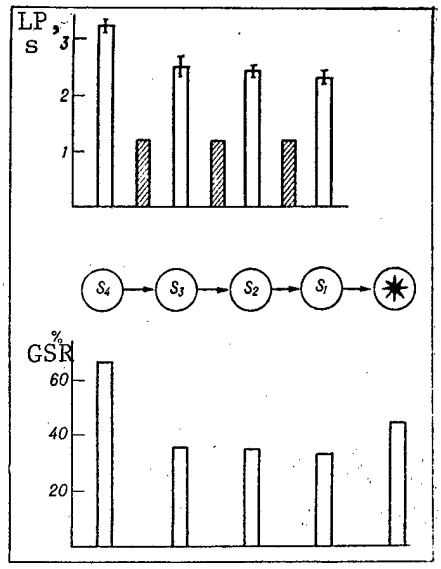

Figure 2.
Latency periods--LP (in seconds) of choice of actions and frequency of GSR (%) as signals S_4, S_3, S_2, S_1 and the star are turned on

Thus, in the course of the program, we could distinguish the times at which the star and first signal in sequence leading to the star were turned on, according to emotional reactions (respiration and GSR), as well as the increase in latency periods of choice of actions. We found that the turning on of the next signals was also emotionally discriminated by the subjects, since GSR appeared significantly ($P<0.001$) and much more often when these signals came on than in the intervals between them (16% of the cases). Moreover, the latency period for choice of action that was first after turning these signals on was considerably longer (2.39±0.06 s) than the latency period of actions chosen second (and third) in the event that the first (or accordingly the second also) was erroneous and there was no switching of signals (1.2±0.03 s).

Thus, the autonomic reactions of the subjects to events in the program, as well as change in latency period of action choice at different stages of the program, revealed a certain hierarchy, manifested by the fact that stronger emotional reactions accompanied appearance of the star and turning the first-stage signal on, while weaker reactions were associated with turning on the signals of successive stages leading to the star, and very seldom did reactions appear in intervals between the intermediate signals.

The relationship of autonomic reactions (respiration and GSR) to reaching the star was manifested from the very beginning of program P-1, and it persisted to the end of program P-2. There was an increase in correlation between GSR and the successive signals as performance of program P-1 progressed. At the start (first 8 chains), the link between times of appearance of GSR and successive signals was considerably weaker ($P<0.01$) than in the middle or when performing program P-2.

The obtained data warranted the assumption that, under the described conditions, learning occurred on the basis of formation of functional systems on two hierarchic levels corresponding to two levels of motivation. According to the objective of activity specified in the instructions, the main motivation was directed at producing the star. In the course of learning, there is also formation of "intermediate" motivations directed at obtaining intermediate signals. According to such hierarchy of motivations, we can also conceive of the corresponding hierarchy of functional systems to implement the interim and end results.

Within the framework of this hypothesis, the obtained data on frequency of GSR and various latency periods of choice of actions at different stages of the program can be interpreted as follows. When the first signal in the chain is turned on, there is afferent synthesis in the "large" functional system. The appearing GSR is a reflection of motivational excitation directed at obtaining the star. Taking into consideration the engrams of memory about prior chains, there is formation of a program of actions from the first stage to the star. This process of "running through" the possible variants of reaching the goal in memory requires some time, which determines the latency period of choice of action at this initial stage. If the program is performed well and the intermediate results conform with those in the acceptor, the latency period of choice of action is shorter at the different stages and there is no GSR. However, due to changes in the program, as well as possible mistakes in choice of the "large" program at different stages there may be a discrepancy between the proposed and obtained results. Then there is afferent synthesis in the subsystem, in which motivational excitation is directed toward obtaining the next interim signal. Then the latency period of choice of actions increases and GSR appears, which is an indication of motivational excitation involved in this afferent synthesis. However, since such "interim" afferent synthesis does not occur at all stages and, moreover, it has a shortened program of action (only one action is chosen), the average frequency of GSR and latency period of choice of actions at stages S_3, S_2 and S_1 are lower than at stage S_4.

On the basis of the hypothesis of formation of hierarchic functional systems during learning and their mechanisms, it was possible to also interpret the features found in the pattern of frequencies of choice of actions (see Figure 1), as well as to visualize the general picture and model of intuitive learning by man.

A careful analysis of the frequency pattern obtained (see Figure 1) revealed that, along with the main feature--increase in frequency of choice of correct actions reinforced in the preceding chain--it also presented other features that require special analysis. An explanation for the drastic increase in

frequency of choice of correct actions was offered previously on the basis of the principle of active screening of highly determined events during learning (Ye. A. Umryukhin, 1979). For this reason, let us concentrate on analysis of other features that are more difficult to explain.

In addition to the appreciable increase in frequency of choice of correct actions, it was considerably different from a random choice of actions, which were correct for the next stage of the program. Thus, at stage S_4, the mean frequency of choice of action d_3 for the 8 chains (which is correct for the next stage S_3) constituted 0.270±0.018. This frequency is significantly ($P<0.0001$) higher than the frequency of choice of the other two actions (0.146 and 0.090). Similarly, at stage S_2, there was a significantly ($P<0.01$) higher frequency of choice of actions, which was reinforced at the next stage, S_1.

We can interpret this pattern as the consequence of choice of action by means of the mechanism of anticipatory excitation (P. K. Anokhin, 1968; K. V. Sudakov, 1976).

In afferent synthesis in the functional system corresponding to reaching the star, "running through" the possible programs of future actions and results (from the first stage to the star) could end with the choice, not of the next action, but the one that was correct at subsequent stages. Such a choice of action with anticipation was also inherent in the early stages of learning on program P-1, and it could be the consequence of insecure memory traces and incorrect use thereof at the early stages of learning.

The frequency of chosen actions demonstrated a pattern ($P<0.001$), consisting of the fact that the frequency of choice of correct actions was highest (up to 0.6-0.8) only in those cases when both the intermediate signal and preceding action, by means of which this signal was obtained, coincided with the action and signal of the preceding chain. When the preceding action was different, this frequency dropped appreciably ($P<0.001$). Moreover, at some stages of the program, the choice of action following another in a combination that was reinforced at other program stages in the preceding chain differed substantially from a random choice ($P<0.001$).

Thus, in the second chain of the program there was reinforcement of the action sequence d_2-d_3 when the signals of the corresponding stages S_4-S_3 were turned on. In the third chain, action d_2 at stage S_2 turned on the signal of stage S_1 and, although this signal differed from the signal of stage S_3, after action d_2, action d_3 was chosen at a high frequency (0.48--significant increase of level $P<0.001$).

These findings can be explained if we assume that afferentation about the action of the preceding stage plays a large part in afferent synthesis in the subsystem of one of the stages with regard to choice of action.

It was found that the influence of two afferentations (visual, from the turned-on signal, and kinesthetic, from the action) is not additive. In those cases where both coincided in choice of actions with those that were

present during reinforcement, there was an 0.3-0.4 increase in share of subjects that chose the reinforced action. Estimation of this share on the assumption of additive independent connection of both afferentations yielded a value of 0.1-0.2, which is considerably smaller ($P<0.01$) than the actual figure (0.3-0.4).

A statistical check was made of the corollary of the hypothesis of combined coding of action and signal and inclusion of such codes in intermediate afferent synthesis and the acceptor of action results. Proceeding from this premise, an estimate was made of the distribution of frequencies of choice of actions and combinations thereof at different stages of the program. They were compared to distributions corresponding to other possible hypotheses (for example, exact memorization of order of actions), and in all cases the actually observed distribution of frequencies corresponded to the assumption of combined coding of action and signal.

There was a discrepancy between the proposed results and those obtained on program P-2 when the program was changed in the three stages, at which there was a high frequency of choice of correct actions. It was found that the discrepancy between the obtained and expected result resulted in a decrease in share of subjects who chose the correct actions in the next chain, not only when choosing actions at the same stage of the program, at which there was a discrepancy, but at other stages. Thus, at stage S_2 of the 6th chain, the frequency of choice of action d_2 dropped from 0.419 to 0.351 ($P<0.05$) due to discrepancy at stages S_4 and S_1 in the 5th chain.

The frequency of choice of correct action was also lower at the next stages of the same chain, due to discrepancy at the preceding stages.

A discrepancy at one of the program stages, manifested by a decrease in frequency of choice of reinforced actions at other stages in the same and next chain, could be interpreted as a change in program of action as a result of mismatch between the planned result and the one obtained in the large acceptor of action results, in which the entire chain from the first stage to the star is represented.

A mismatch was also demonstrated in the significant ($P<0.01$) increase in latency period of choice of actions at the next stages of the chain after the mismatch, as well as in the next chain at the stage where the mismatch occurred.

Appearance of GSR and increase in latency period after a mismatch can be interpreted as the consequence of expansion of afferent synthesis due to broader involvement of memory traces.

The interpretation of GSR and increased latency period when a man learns with program P-2, as indicators of breadth of afferent synthesis (more extensive use of memory traces) was checked by comparing the consequences thereof to experimental data. We found that, in those cases where the latency period of choice of action was extended and this choice was preceded by GSR (i.e., GSR appeared 1.5-2 s before the action was performed), correct actions were chosen much more often ($P<0.0001$) than in the cases where the choice of action

was not preceded by GSR and increase in latency period. When the choice of actions preceded by GSR resulted in a mistake, this mistake was due much more often ($P<0.001$) to memory traces formed in previous program units and less often due to random factors (for example, sorting), than in those cases where the choice of action occurred without prior GSR.

Thus, with expansion of afferent synthesis (increased latency period and appearance of GSR), memory traces corresponding to actions reinforced in previous units of the program and "seemingly" forgotten were used more frequently.

The increase in latency period inherent in stage S_4 and more frequent appearance of GSR with choice of action at this stage can be attributed to expansion of afferent synthesis due to formation of a program of actions over the entire chain up to the star.

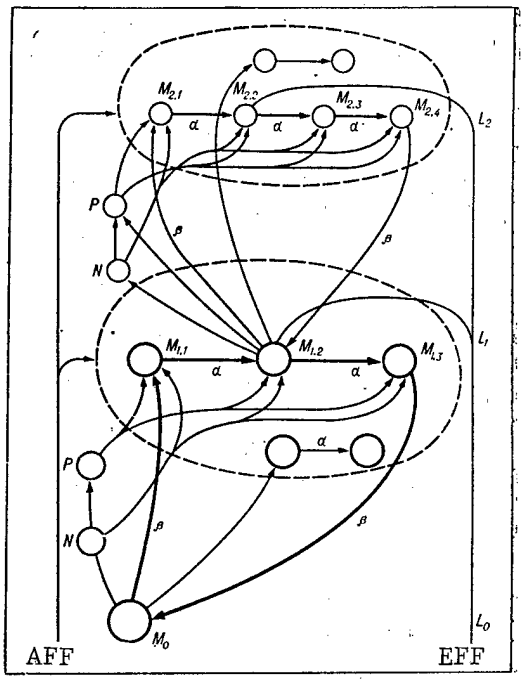

Figure 3.
Model of hierarchic functional systems. Explanation is given in the test.
AFF) afferentation
EFF) effectuation [sic]

The described views on mechanisms of human intuitive learning can be presented in the form of a model. In Figure 3, this model is shown in the form of a simplified structural diagram. There, the circles refer to elements M, which encode certain events in the exogenous and endogenous environment; the arrows show links α and β between elements, over which excitation of one element is transmitted to another. N and P refer to elements, upon excitation of which there is a change in conduction of connections (positive and negative reinforcement).

The choice of program of actions and results in the model can be described as follows. The dominant motivation M_0 on level L_0 causes dissemination of motivational excitation in memory elements on the next level L_1. "Running through" in memory the possible variants of routes toward achieving results satisfying motivation M_0 "chooses" the elements of memory $M_{1,1}$, $M_{1,2}$ and $M_{1,3}$ in which the route is coded from the existing state of the environment ($M_{1,1}$) via intermediate results ($M_{1,2}$; $M_{1,3}$) to satisfaction of motivation M_0. The absence of intermediate result $M_{1,2}$ leads to appearance of motivational excitation, which spreads from element $M_{1,2}$ in the memory of the next level of integration L_2 and similarly a choice is made of memory elements $M_{2,1}$, $M_{2,2}$ and $M_{2,3}$ which code the intermediate results of the next level L_2, obtaining which assures achievement of result $M_{1,2}$. Successive isolation of the next levels could be continued.

When performing a planned program, the topmost level of the model corresponds to motoneurons, while the deeper levels determine the general adjustment of motor activity that is required to achieve the results corresponding to these levels.

On the basis of this model, we can conceive of the specific expression of all of the above-described mechanisms of man's intuitive learning. The principal ones are choice of program of actions and future results in the presence of spreading motivational excitation, adjustment of the program of actions and results when there is a discrepancy between the obtained results and those of the acceptor of action result, hierarchy of functional systems, which is based on the hierarchy of motivations. The memory elements of one level are motivational elements in relation to the overlying level.

The question arises as to whether one can apply the above scheme to analysis of man's conscious activity as well. It can be assumed that conscious activity, which is ultimately effected by means of physiological mechanisms similar to those we have discussed, is also determined appreciably by complex information processes, which are the result of man's upbringing and development in a specific social environment. A somewhat simplified analogy could be the software for modern calculators, which includes universal operating systems. The language in which the computer operates and the programs it runs, while realized by means of specific physical devices, are substantially determined by the creator of the operating system. With reference to physiological mechanisms of conscious activity, we must mention two important factors, which should be added to the above-mentioned scheme. The first is memory about the sequence in time of important events which, unlike associative memory, makes it possible to consciously combine a man's life experience in a single picture and, perhaps, constitutes the basis of the unity of self-awareness. The second factor is related to reflection in consciousness only of the "large" [major] codes, which are related to the possibility of verbal presentation. In the aspect of the above scheme, it is obvious that both the top levels--direct motor realization of movements--and the deepest ones, which are related to biological motivations, are essentially beyond the sphere of consciousness. There is awareness of goals, desired results, as well as programs of actions, which are encoded in the form of general information units. In the experiment described above, this was manifested by awareness of programs of actions corresponding to entire chains and intuitive choice of different actions.

It must be conceded that the above model of systemic organization of subconscious mechanisms of human activity are, of course, hypothetical in many respects for the time being. However, its conformity to experimental data and general theory of functional systems (P. K. Anokhin, 1968; K. V. Sudakov, 1976) warrant consideration thereof as promising with regard to use in future studies.

BIBLIOGRAPHY

1. Anokhin, P. K., "Biology and Neurophysiology of Conditioned Reflexes," Moscow, 1968.

2. Idem, VOPR. PSIKHOL., No 4, 1974, pp 21-29.

3. Kostandov, E. A., in "Bessoznatel'noye: priroda, funktsii, metody issledovaniya" [The Unconscious: Nature, Functions and Methods of Investigation], Tbilisi, Vol 1, 1978, pp 633-650.

4. Sudakov, K. V., USPEKHI FIZIOL. NAUK, No 4, 1976, pp 26-60.

5. Idem, in "Vysshiye funktsii mozga v norme i patologii: pamyat' i emotsii" [Higher Functions of the Brain Under Normal and Pathological Conditions: Memory and Emotions], Leningrad, 1979, pp 92-116.

6. Sudakov, K. V. and Kotov, A. V., in "Bessoznatel'noye: priroda, funktsii, metody issledovaniya," Tbilisi, Vol 1, 1978, pp 596-605.

7. Umryukhin, Ye. A., VOPR. PSIKHOL., No 3, 1976, pp 149-154.

8. Idem, in "Bessoznatel'noye: priroda, funktsii, metody issledovaniya," Tbilisi, Vol 3, 1978, pp 674-686.

9. Idem, in "Sistemnyy analiz mekhanizmov povedeniya" [Systems Analysis of Behavior Mechanisms], Moscow, 1973, pp 91-104.

10. Shumilina, A. I., in "Printsipy sistemnoy organizatsii funktsiy" [Principles of Systemic Organization of Functions], Moscow, 1973, pp 169-180.

11. Gazzaniga, M. C., "The Bisected Brain," New York, 1970.

12. Libet, B., in "Brain and Conscious Experience," Berlin, 1966, p 165.

13. Sperry, R. W., PSYCHOL. REV., Vol 76, 1969, pp 532-536.

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CSO: 1840/233

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DYNAMICS OF INTERHEMISPHERE FUNCTIONAL RELATIONSHIPS IN FORMATION BY TEMPORARY CONNECTION BETWEEN VISUAL SIGNAL AND UNRECOGNIZED WORD

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian
Vol 31, No 5, Sep-Oct 81 (manuscript received 11 Sep 80) pp 899-908

KOSTANDOV, E. A., ARZUMANOV, Yu. L. and POGREBINSKIY, S. A., All-Union Scientific Research Institute of General and Forensic Psychiatry imeni V. P. Serbskiy, Moscow

[Abstract] An attempt was made, by studying functional connections between hemispheres established upon formation of a temporal connection with the participation of an unrecognized reinforcing verbal stimulus, to trace the physiological basis of the phenomenon of psychological defense, one of the central aspects in the problem of the unconscious. Twelve males were studied, 18 to 24 years of age, right handed, with normal vision. All of the subjects were in severe conflict life situations, having performed illegal actions in a state of jealousy. The subjects were instructed to stare at a light spot on a screen in a darkened room, and visual stimuli were flashed on the screen on either side of the spot while EEG's were recorded. When a nonverbal visual stimulus was combined with an unrecognized emotional word the functional relationships between the hemispheres changed significantly. The latent period for the first stimulus decreased in the left occipital area. The amplitude of the potential significantly decreased on all sections of the cortex, particularly in the left hemisphere. Conditioned reflex changes in the P_{300} wave potential in tests in which the reinforcing stimulus was not recognized were quite persistent and did not decrease in spite of repeated use of the signal without combining it with the emotional word. Figures 4; references 12: 8 Russian, 4 Western.
[150-6508]

UDC: 612.821.6+612.821.3

SPECIFICS OF SOLUTION OF VISUAL AND VERBAL PROBLEMS BY 5 TO 7 YEAR OLDS

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian Vol 31, No 5, Sep-Oct 81 (manuscript received 23 Jun 80) pp 909-915

STEPANOV, V. Ye., Gor'kiy Scientific Research Institute of Pediatrics, RSFSR Ministry of Health

[Abstract] A comparative study was undertaken of age and sex specifics of neurodynamics during correct and incorrect solution of visual and verbal problems of various levels of difficulty by children in two neighboring age groups, 5-6 and 7-8 years. The visual problem involved selecting the lamp from among a group of lamps flashed in several patterns which was included in all the patterns. Verbal thinking was studied using 30 problems recorded on magnetic tape, each of which required listening to a number of characteristics and naming the object which all the characteristics described. The 5 and 6 year olds could solve only the simplest problems, boys better than girls in both cases. The 7 and 8 year olds could solve practically all the problems, a result of the increasing dominance of the second signal system. At this age group, the girls were more successful with the visual problems, the boys with the verbal. Three stages of development of processes of summarization of complex signals are distinguished. The 5 to 6 year olds do not go beyond the first stage, 1 to 1-1/2 years later they reach the third stage. The relationship of correct to incorrect answers and the time required to solve the problems can be used to judge the true biological maturity of a child's brain. References 10 (Russian).
[150-6508]

UDC: 612.822.3+612.84

NEUROPHYSIOLOGICAL MECHANISMS OF CHANGES IN VISUAL PERCEPTION IN CHILDREN 3 TO 7 YEARS OF AGE

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian Vol 31, No 5, Sep-Oct 81 (manuscript received 26 Jun 80) pp 994-1000

BETELEVA, T. G., Scientific Research Institute of Physiology of Children and Adolescents, USSR Academy of Pedagogic Sciences, Moscow

[Abstract] Electrophysiological studies were performed on 30 children 3 to 4 years old and 21 children 6 to 7 years old, psychophysiological studies involved 12 children 3 to 4 years old and 11 6 to 7 years old. Analysis of the amplitude characteristics of individual evoked-potential components in response to the presentation of a homogeneous square, checkerboard and face were used to estimate the reactivity of the cortical zones during performance of various operations involved in perception. During the period from 3-4 to 6-7 years the topography and reactivity of evoked potentials undergo

significant changes. At 6 to 7 years of age, clear specialization of areas in the performance of individual operations of analysis of visual stimuli develops, not seen in the younger group. The focus of maximum reactivity in distinguishing elements of a contour becomes the occipital area. The second focus of reactivity is in the central area. The configuration and reactivity of evoked potentials in the tempro-occipital area changes at 6 to 7 years of age, with the negative component which will be dominant at 9 to 10 years of age appearing in 42% of cases. The specifics of visual perception in children 3 to 7 years of age are determined by the nature of involvement of nonprojection areas of the cortex in the analysis of visual stimuli. Figures 4; references 25: 18 Russian, 7 Western.
[150-6508]

UDC: 612.822.3+612.821+612.821.6

EEG EVALUATION OF MENTAL STRESS

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian Vol 31, No 5, Sep-Oct 81 (manuscript received 5 Dec 80) pp 1071-1075

VOLKOVA, I. M. and GORSHKOV, S. I., Department of Labor Physiology and Ergonomics of the Clinic, Institute of Labor Hygiene and Occupational Diseases, USSR Academy of Medical Sciences, Moscow

[Abstract] A study is presented of the success in performing an informational visual search as a function of the previous period of preparation and its duration, a study of the electrophysiological correlates of this activity, its effectiveness, preparedness and relationships among centers arising during the process. The study involved 8 students exposed to Grunbaum tables in which an information search was performed. In some of the experiments an audible ready signal was given before the information search task was presented. A warning signal 5, 10 or 15 seconds before the beginning of the search resulted in a significant reduction in search time. Differences in EEG rhythms were observed when the warning signal was given, with an increase in cortical activity in the precentral area. The period of readiness before the search leads to an increase in activation, reactivity of neuron systems, facilitating rapid mobilization of the central nervous system and neuromotor apparatus, but the level of activation of cortical structures and the degree of mobilization of functions depends on the interval between the ready signal, and is phased in nature. Figure 1; references 7 (Russian).
[150-6508]

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